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TRANSACTIONS

OF THE

AMERICAN ENTOMOLOGICAL SOCIETY

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THREE NEW SPECIES OF NORTH AMERICAN DRAGONFLIES WITH NOTES ON RELATED SPECIES

BY JAMES G. NEEDHAM

Cornell University

(Plate I)

In the following pages there are described three new species: a *Gomphoides* from Texas, a *Gomphus* from North Carolina, and another from Alabama; also redescribed is the nymph of a species of *Macromia* from Mexico.

Gomphoides albrighti new species (Plate I, fig. 2.)

This species is blackish, brightly marked with yellow. The face is pale, sparsely besprinkled with short black hairs. The labrum is creamy yellow with a faint marginal band of brown. There is often a half-length dash of darker brown on its mid-dorsal line, and sometimes a pair of round brown dots appears at the front end of this dash. The front margin of the labrum is fringed with short stiff reddish hairs. Dark shadowy bands of pale brown overlie both interclypeal and frontoclypeal sutures. The top of the head is blackish, with two large pale areas, one on the vertex behind the ocelli and one on the middle of the occiput. The transverse ridge of the occiput is slightly convex. The rear of the occiput is dark brown with a large median pale area.

The prothorax is brown above with a yellow-margined front lobe, a diffusely yellow pale median area and yellow spots covering the outer angles of the disc. The synthorax is scantily hairy on and near the collar, and elsewhere smooth and shining. Conspicuous on its front is a triangle of black, connected with the black dorsal crest above and elsewhere surrounded by a bright yellow pair of opposed 7-marks that meet on the collar below. The black is narrowly divided on its middorsal line by a yellow streak on the carina. On the sides of the synthorax the four usual dark stripes are well developed, and an additional one is added. The antehumeral stripe is broad in the middle and narrower toward each end. The three sutural stripes are all well developed, complete, and about equal in breadth to the intervening yellow. All these black stripes are conjoined by black along the subalar carina above, and near the leg bases below. The last one, the 3° lateral, is prolonged downward and backward from its lower end, and then recurrent upward at the rear so far that it forms at the hind margin of the synthorax a sixth thoracic stripe.

The legs are pale at the base, black beyond, with streakings of paler extending outward on the sides of the femora. The front femora are more extensively yellow beneath. The leg spines are black. The wings are hyaline with brown veins and stigma. Sometimes there is a tinge of yellow in the membrane at their bases. The costa is yellow or whitish on its front edge. There are generally three cells in the triangles and two in the subtriangles of both fore and hind wings and three in the anal loop, but there is considerable variation in these members and in the placement of crossveins that separate the cells.

The abdomen is moderately swollen on its tapering segments 1 to 3. It is widened again on 7 to 9, mainly by means of paired leaflike lateral expansions of the latter segments. It is predominantly blackish with tawny crossbands of yellow on the middle segments that become diffuse on the end segments. There is a middorsal pale stripe on segments 1 to 7, wide, narrowing to rearward on 1 to 3; tapering and more or less interrupted on 4 to 7; diffuse beyond. There is also an inconspicuous stripe of yellow low down on the sides of 1 to 7. It covers about half of the sides of 1 and 2 (allowing two little clouds of brown on 2). It is greatly reduced to squarish basal spots on 3 to 6. It is widened again on 7 to a conjunction with the yellow of the dorsum, the two thus together forming a pale basal ring on 7. Segments 8 and 9 are crossed and almost covered by two ill-defined bands of blackish that leave only paired rust-colored spots at front and rear margins and lengthwise streaks on the leaf-like lateral expansions. These leaves are broad enough to almost double the width of 8 and 9. They are semi-oval and smoothly margined. They extend to rearward on 8 a little beyond the level of the apical border of the segment. They are not quite as broad or as long on 9 as on 8. Segment 10 is pale yellow with only a touch of brown across the base above.

The caudal appendages of the male are yellow. There is a little patch of long hair on the inner side of the superiors at the base. Their upcurved tips are black; their outer sides toward the base are blackish. The inferior appendage is less than half as long as the superiors. It is thin, flat and upcurving. It is deeply bifid by a straight-edged V-shaped median cleft. It is so soft that in drying the inner edges may be creased by upfolding.

The female is like the male in coloration. At full maturity both male and female become more blackish. The yellow markings at the base of the leaflike expansions of 8 and 9 may wholly disappear, and a thin dusting of pruinosity may appear on the under side of the thorax.

The genitalia of the 2nd segment are well-nigh hidden under the double line of hairs they bear. Only the anterior hamule is bare and shining. It widens upward to a blunt end with a notch in it, an incurving tooth each side of the notch. The peduncle of the penis is strongly inclined to rearward under the sternum of segment 3 and is more prominent than the hamules.

The subgenital plate of the female is about a seventh as long as the sternum of 9 against which it lies. It is deeply divided by a rounded U-shaped cleft into a pair of blunt-tipped triangular flaps.

This species is like *stigmatus* in having the forcipate superior appendages armed with two teeth on the incurving distal part well before the upturned, truncated and chisel-edged tip, but the curvature is slight in *albrighti;* strong in *stigmatus,* almost to angulation when viewed squarely from the side. The inferior appendage is divided by a widely gaping V-shaped cleft in *albrighti;* by a narrow, nearly parallel-sided cleft in *stigmatus.* The hair fringing the genitalia of the 2nd abdominal segment is black in *albrighti;* tawny in *stigmatus.* The anterior hamule is only about half as broad in *albrighti* as in *stigmatus;* the notch in its tip is shallower, the tooth before the notch is larger; and the one behind the notch is followed by very minute lesser inflexed denticles that are lacking in *stigmatus.* The cleft in the subgenital plate of the female is wide and roundly U-shaped in *albrighti;* shallower (though the plate itself is smaller) and V-shaped in *stigmatus.*

This species is described from nine specimens, three males and six females, all taken by Paul N. Albright from the San Antonio River near Berg's Mill, Bexar County, Texas: a single female, September 18, 1948; the others June 12 and 14, 1949. Among the nine are both teneral and adult specimens of both sexes.

Holotype No. 2581, Cornell University collection. Male.

Paratypes, all the others.

Mr. Albright's note accompanying the first specimens received from him is as follows: "I caught four of them. They were quite wary, and were captured only by creeping up on them very slowly, and without any quick motions. They are not ordinarily very fast in flight."

A Search for *Gomphus Brimleyi*

Before proceeding to describe the next species, something should be said about the means taken to find *Gomphus brimleyi* for comparison. Muttkowski described *brimleyi* from seven specimens that had been collected by Professor Franklin Sherman "in open pine woods near the banks of White Lake in Bladen County," North Carolina (Ent. News, 22: 222–223, 1911). Four of these specimens (two pairs) Muttkowski deposited in the Milwaukee (Wis.) Public Museum. Another pair he placed in the Williamson Collection of the Museum of Zoology of the University of Michigan.

The species was described largely by comparison with *Gomphus cavillaris,* which it closely resembles.

Assuming that the sole remaining specimen of the seven was still in the possession of Dr. Brimley, I asked him for the loan of it, and he sent me a specimen at once. It bore in his own handwriting two pin labels: "Brimleyi," and "Aberdeen, N. C. 14 Apr. '27, C. S. Brimley." I wrote him that this specimen did not agree with Muttkowski's figure and description, and that it appeared to be undescribed. Whereupon, with characteristic generosity, he wrote me (on Dec. 30, 1941):

"Retain the specimen of *brimleyi!!* and if it is new, deposit it wherever you deposit your types.

"I have a dim impression that I looked at its appendages before I sent it and they did not look quite right for *brimleyi.*"

It was not *brimleyi.*

I then went to the Museum of Zoology at Ann Arbor and found the two paratypes, one of which, the female, was labeled "Paratype Muttk.," and I noted at the time that it differed from the male by having the second (midlateral) and third thoracic side stripes separate and distinct, and had in the trigonal interspace of a forewing two through-cells reaching from vein M4 to Cu1. The male appeared to be quite like the specimen that I had received from Dr. Brimley. Being unable to go to Milwaukee at that time, I asked Mrs. L. K. Gloyd to go for me at her convenience. I sent her a drawing of the superior appendages of Dr. Brimley's specimen, and for further comparison, some of my own specimens of

Gomphus cavillaris from Florida. She wrote me on date December 29, 1945, that the specimen there labeled "Holotype" is *cavillaris,* and that a male marked "paratype" agrees better with Muttkowski's figure and description; and she suggested that possibly the holotype label got put on the wrong specimen. She further stated that the other male "paratype" had the inner tooth on the superior appendage similar to the *"brimleyi"* specimen, that I herein describe as *diminutus. G. brimleyi* is very much nearer to *cavillaris* than to *diminutus.* The anterior hamule of the male is of unique form in *cavillaris* and *brimleyi:* slender and sway-backed, its tip distinctly surpassing the shoulder prominence of the posterior hamule; on its tip a single backwardly directed terminal hook that it visible in lateral view.

Mrs. Gloyd also reported on the paratypes in the Williamson collection at the University of Michigan, and sent me the following data on single full-width cells in the trigonal interspace in *cavillaris.* She found there 26 specimens of *cavillaris,* 15 males and 11 females, from seven localities in Florida: Enterprise, Gainesville, Gotha, Maitland, St. Petersburg, White Lake, and Winter Park. All *cavillaris* specimens had at least one full-width cell and it was never next the triangle; generally came with the second cell beyond the triangle.

Desiring to know something more of the range of variability in *cavillaris,* I examined 71 specimens in my own collection, 42 male and 29 female forewings, with the following results:

Full-width Cells in the Trigonal Interspace of Front Wing

Number of these cells	0	1	2	3	4	5	6
Number of times occurring .... ♂		1	6	13	34	24	6
" " " " .... ♀	6	2	3	16	14	11	6
Total for both sexes	6	3	9	29	48	35	12

These figures show that in the clearing out of crossveins from the membrane, the females lag a little, nearly a fourth of them having no full-width cells in the trigonal interspace. All these males have at least one.

A chance of further light on the question of the validity of *G. brimleyi* came opportunely when I received a letter from Dr. D. L.

Wray telling me of a specimen in the State College collection at Raleigh, N. C., labeled "*G. brimleyi* type," and offering to lend it to me for study. Here was the missing 7th and last of the lot of White Lake specimens on which the original description of *brimleyi* was based. I was greatly disappointed on opening the package that brought it to find it in fragments, some newly made, more from former breaks repaired with gobs of shellac. A pin, run through the body for support, had wrecked the genitalia! The superior caudal appendages were lost; the inferior was half gone. The genital hamules of the second segment on their frame base were miraculously preserved intact. Glued to the pin there were enough pieces of the abdominal terga, when freed by a solvent, to show that the color pattern is in close agreement with Muttkowski's description. I think it is the true *brimleyi*.

The Brimley specimen, "*brimleyi*", I will now describe as a new species.

Gomphus diminutus new species (Plate I, fig. 3.)

Length 40 mm.; abdomen 29; hind wing 23.

This is a very small olive green species, rather faintly striped with brown. Head and thorax are thinly clothed with brownish hairs. The rather smooth blackish abdomen is mostly bare. Face and mouth-parts are olivaceous, with faint lines of brown around the margin of the labium and in the transverse sutures. Base of frons above and all the vertex black; antennae black save for a very narrow pale ring around the base of each. Occiput yellow, with its upper edge very slightly convex and fringed with long black hairs.

Prothorax brownish above, with yellowish front lobe, lateral spots and a submedian twin spot on the middle lobe. Synthorax yellow, striped with brown. The rather broad middorsal stripe, widened forward to the collar, and narrowly divided by the yellow of the middle of the carina. Antehumeral brown stripe isolated above and narrower than the yellow area before it, and separated from the brown humeral stripe by a narrower stripe of yellow. Behind the rather wide brown humeral stripe the sides of the thorax are dull yellow with a single broad band of brownish that covers the second and third lateral sutures and all the area between them.

Legs blackish, pale basally and on the sides of the femora. The hind femora are long. The tibiae are paler on the outer side. The wings are hyaline with brown veins and a tawny stigma. There is a very faint pale line on the costa. Nodal crossveins are 11:8 and 8:8 on fore and hind wings respectively. There are three crossveins under the stigma. Anterior and inner sides of the fore wing triangle are about equal in length. In the trigonal interspace of all four wings there are just two rows of cells at first, except that in the right fore wing there is a single through-cell from M4 to Cu1, the cell arrangement by pairs in that wing being, 2,2,2,1,2,2,2,2, the number increasing thereafter.

Abdomen black with the usual middorsal line of yellow spots. At the front the yellow covers most of the dorsum of segment 1; is still wide and full-length on 2; and is thereafter narrower and progressively reduced in length on segments 3 to 7; the yellow reappears on the hind end of the lateral margin of 8, and diffusely covers most of 8 and 9. The sides of 1 to 3 are mostly yellow, including the auricles on 2. Segment 10 is obscure pale brownish. There is a conspicuous tuft of black hair at each side of the dorsum of segment 1. The relative length of the four end segments is as 10:9:10:6, with the appendages about 7 on the same scale.

The superior appendages of the male are moderately divergent. The branches of the inferior are much more widely outspread. Viewed from above each superior appendage shows four projecting angles; its apex projects as a long tapering sharp point directly to rearward; on the outer side at nearly two-thirds of the total length a rather sharp angular tooth projects laterally. Opposite that tooth on the inner side two blunt teeth project inward and obliquely downward. The proximal one, shaped like a little thumb, is twice as long as the other. The other one is merely an angulation of the lower margin.

The branches of the inferior appendage in lateral view are, in their basal half, about as thick as the superior, and if their strongly upcurved tips were straightened out they would be slightly longer than the superiors. They are fringed internally with rather long, stiff hairs. The superiors are bare. When the inferior appendage is viewed from beneath, the spread of its branches is so wide and so regular that its hind margin forms a segment of a circle.

The genitalia of segment 2 are prominent and mostly colorless and hairless. The anterior hamule is small; shorter and stouter than that of *cavillaris*. It widens upward to a blunt top, is channeled on the inner side and bears two terminal teeth that are sharp, equal, and so strongly inflexed as to be visible only in ventral view. At each side of them the terminal margin ends in a low rounded lobe. Between the rear lobe and the adjacent tooth are one or more very minute denticles.

The posterior hamule is nearly three times as long as the anterior one. It is broadest at the low shoulder on the front margin. It is straight-backed on its hind margin from near its base to the sharply-inturned hook-like tip. It is strongly inclined to rearward. It is more or less flat its full length.

The penis is long. The hood of its peduncle is shaped like an easy arm-chair, facing forward, hair-lined within, and with out-rolled arms. The pale tail at the tip of its small fourth segment is hardly longer than the body of that segment; and on the thin body is a quadrate black spot. The penis guard rises from the floor of the genital pocket and is longer and curves higher than usual in *Gomphus*. It has a trilobed tip. The middle lobe of the tip is elevated and arched in the form of a beak and striated lengthwise down its very convex back.

Holotype: male, no. 2585 in the Cornell University Entomological Collection.

This specimen was collected by Dr. C. S. Brimley, near Aberdeen, North Carolina, on April 14, 1927.

On a visit to the University of Alabama, at Tuscaloosa, Dr. Hodges called my attention to a local specimen that is very similar in appearance to *G. brimleyi*, and then he kindly sent it to me for study. Describing it herewith, I take pleasure in naming it in his honor.

Gomphus hodgesi new species (Plate I, figs. 4 and 5.)

Length 44 mm.; abdomen 33; hind wing 26.

This is a very slender olive-green species, with black abdomen. The face is all pale greenish, shining, thinly beset with short sparse black hairs at the sides and across the base of the labrum. The margins of the labrum and the lower edges of the facial lobes are whitish. The top of the frons is shining green, except for a low narrow quadrangle of black thrust forward upon its base from the black of the vertex. The frons is high and unusually prominent and bears a well-defined transverse crest. The vertex is black, except for a somewhat brownish rearward slope behind the sharp ocellar carina. The occiput is greenish, slightly convex on its crest, where it is beset with thin scattering hairs.

The middorsal stripe of the synthorax widens forward into a broad triangle of black, and ends above the dark gray-green collar. At the upper end this stripe spreads out laterally to cover the entire thoracic crest. The antehumeral dark stripe is incomplete, ending in the green at its upper end. Below it runs straight down across the supra-coxal plate. The humeral dark stripe is wide at the crest, narrows and is parallel-sided below the humeral pit. It runs down into the supra-coxal furrow and around a bulge in the mesepimeron, to join the midlateral stripe below the bulge. The pale streak between the two humerals is narrow and irregular. The midlateral and third lateral stripes are complete, though not sharply defined, and they are joined above by the shiny black subalar carina. Behind these stripes the metepimeron is broadly greenish white. The venter of the synthorax is wholly pale. It is thinly clad with long white hairs.

The legs are pale at base, on the under side of the femora, the upper side of the tibia, and the upper side of the first two joints of the tarsi. The hind femur is strikingly long (6 mm.). The wings are hyaline, with a faint tinge of brown in the membrane beyond the nodus. There is an indistinct white line on the costa. The veins are black, the stigma brown. There are five paranal cells in the forewing, with no added marginals; five in the hindwing also, two of which are in the first anal interspace. The tornal cell is nearly half the height of its interspace, and above it there are two full-width cells.

The slender abdomen is very little clubbed on its end segments. It is black with a dull greenish-yellow middorsal stripe that is continuous from the base to the end of segment 8, wide on 1 and 2, narrowing on 3, parallel-sided on 4, 5, and 6, narrowing again on 7 and fading out on 8. There is, also the usual lateral stripe, and it is green in color and wide on segments 1 to 3; covers about the lower half of 1 and 2, including the auricle. It narrows on 3 and is reduced to round basal spots on 4, 5, and 6; widens greatly for full length on 7, 8 and 9, and becomes yellow; bright yellow on the slightly flaring lateral expansion of these segments; is clouded above the yellow on 7 and 8. Segment 10 is dull black above and dingy yellow below.

The caudal appendages are dull olive washed with black, and with very black tips.

The genitalia of the second segment are greenish-yellow with black tips. The anterior lamina rises in triangular pyramidal form and is black edged. The anterior hamule does not rise above the level of the shoulder of the posterior hamule, and differs from *cavillaris* in the much greater width at its channeled top. An obliquely inturned tooth is on the middle of its wide top. The posterior hamule, twice as large, leans and tapers backward to its recurved claw-like tip.

This species differs from *cavillaris* in being smaller, slenderer, blacker; in having a higher frons; and in having the anterior hamule as above stated.

This specimen was collected by Dr. Ralph L. Chermock on April 16, 1948, in Baldwin County, Alabama, one mile south of old Spanish Fort. It is a male in mature coloration. It is the holotype, and it belongs to the Hodges Collection of Odonata at the University of Alabama.

After the foregoing was written, I found, in a collection of Mississippi specimens presented to Cornell University by Mrs. Henry Dietrich, two male specimens of a small species of *Gomphus* that I had earlier set aside as undeterminable tenerals. They were both shriveled and nearly colorless; but when softened and cleared a few moments in KOH, the genitalia expanded perfectly and they proved to be *hodgesi*. The large claw-like tooth on the broad tip of the anterior hamule is unmistakable. Their data: Leaf, Mississippi, May 7, 1931 and Lucedale, Mississippi, March 1, 1932.

In Muttkowski's original description of *brimleyi* he mentions the presence of full-width cells in the trigonal interspace. There are none in either the Alabama or the Mississippi specimens of *hodgesi,* just two regular rows beyond the triangle for some distance outward.

A Mexican Macromia Now Found in Texas

No adult dragonflies of the subfamily Macromiinae have yet been found in Mexico, but their occurrence there has been known since Cabot in 1890 (Mem. Mus. Comp. Zool. Harvard) figured a nymph of a species of *Macromia* from Caderita, south of Monterey, Nueva Leon, collected "by Mr. Couch in 1853." I saw two nymphs in alcohol at M. C. Z. in 1900. On March 4, 1936, I collected four nymphs of the same species in Nueva Leon about 100 kilometers from Caderita. The place was near the crossing by the Mexican national highway of Arroyo de Ramos, about half way between Linares and Montemorelos. A short strip of road ran alongside the arroyo to a drainage canal. The nymphs were taken from the bed of the canal where they lay naked and sprawling on its varicolored sand. The largest was perhaps in the penultimate instar; the others, younger. They possess more color pattern than any other *Macromia* nymph that I have seen.

The next day, March 5, I collected older nymphs of the same species in Texas, near the Mexican border: three specimens from the Nueces River near LaPryor south of Uvalde (one fully grown), and two specimens near Rio Frio, north of Uvalde. These came from muddy stream beds and were less colorful, but seem to be structurally the same species.

Dr. Calvert, in Biologia Centrali-Americana (Insecta, Odonata, 1905), p. 197, records that there is a specimen of *Macromia magnifica* from Arizona in the Museum of Comparative Zoology. Cabot figured the nymph of that species, and it is different. Cabot's figure of it exaggerates the incurvature of the lateral spines of the abdomen. Kennedy's later figure of it (Proc. U. S. Nat. Mus., 318 (1917)) is much better and more detailed.

The brief description accompanying Cabot's figure makes no mention of the parts that are most distinctive of the species in this genus. The new photograph herewith presented shows these parts in better detail; and as I am using this figure for illustrating a new *Manual,* the species should have a name for convenience of reference, and a fuller description. Nymphs in this genus are not more difficult of specific determination than are the adults. I have chosen for a name the name of the locality from which the nymph figured by Cabot came: *caderita.*

Macromia caderita new species (Plate I, fig. 6.)

Nymph

Length 25–27 mm.; abdomen 16–17; hind femur 10; width of head 7.5; abdomen 10.

This nymph is of the familiar macromian form: long legged and sprawling, with a skyline of high dorsal hooks along the middle ridge of the flat abdomen. The eye tips are elevated at the fore corners of the head. The two tubercles at the rear corners are erect and cone-shaped, with rounded tips. The pyramidal horn on the front of the head is sharply upcurved to the tip. There is the usual black ocellar crossband on the head, curved to rearward where the ends cross the compound eyes. A pair of pale dots in the black, mark the location of the lateral ocelli; there is a larger pale spot at its front margin, marking the position of the middle ocellus. The remainder of the frons, its horn and the edges of the labium, are speckled with brown. Three longitudinal paler streaks lie lengthwise on the rear of the head; two lie crosswise on the disc of the prothorax; and there are several irregular paler streaks on the sloping sides of the synthoracic segments. The huge labium has the usual six deeply cut spinule-fringed teeth on the terminal margin of the lateral labial lobe, six lateral setae; and five close-set mental setae, with several additional smaller ones placed nearer the middle line of the mentum.

A broad longitudinal band of darker brown markings covers the middle third of the abdomen. The outer third on each side is paler, being more thinly speckled with brown.

The abdomen is very flat, and the dorsal hooks along its middorsal line on segments 2 to 9 are very prominent, and of nearly equal height; the one on 10 is minute but large enough to show in side view a minute hook terminating its middorsal ridge. The form of these and of the lateral spines on 8 and 9 are as shown in the accompanying figures. The lateral spines are sharp and slightly curved, nearly equal on the two segments. Their outer edge is bare save for a thin line of long soft hairs. The caudal appendages are triangular-pyramidal, somewhat attenuate to their paler tips, superior and inferiors about of equal length, the laterals a little shorter, as shown in the figure given herewith.

This species differs from *D. magnifica* and from all the others at present known from North America, by having much taller tubercles on the rear of the head, by having a much larger dorsal hook on the 10th abdominal segment (the transparent tip of which is lost in our photograph), and by having the other dorsal hooks all of nearly the same height and curvature, none of them straight-edged, along the sky line.

Explanation of Figures

Plate I

Fig. 1 (upper left).—*Gomphoides stigmatus* Hagen. Male; dorsal view of caudal appendages; leaf-like expansion of 9th abdominal segment turned downward.

Fig. 2.—*Gomphoides albrighti* new species. Male, dorsal view of caudal appendages; leaf-like expansions of segments 8 and 9 fully outspread.

Fig. 3.—*Gomphus diminutus* new species. Dorsal view of caudal appendages.

Fig. 4.—*Gomphus hodgesi* new species. Dorsal view of caudal appendages.

Fig. 5.—*Gomphus hodgesi* new species; lateral view of same.

Fig. 6.—*Macromia caderita* nymph, with wings and legs lifted to show the full series of dorsal hooks on segments 2 to 10 of the abdomen; showing also the huge labium, middle horn on the front, and tubercles on the rear of the head.

Figures 1 to 5 are from photographs by Dr. M. J. Westfall, Jr.

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NEEDHAM—NORTH AMERICAN DRAGONFLIES

THE LYCIDAE OF THE UNITED STATES AND CANADA

II. THE TRIBE LYGISTOPTERINI

(COLEOPTERA)

BY JOHN WAGENER GREEN
Easton, Pennsylvania

(Plate II)

The Lygistopterini are distinguished from other Lycinae by possessing the following combination of characters: front horizontal, mouth anterior; pronotum with a longitudinal median impression, and an oblique linear elevation each side joining the lateral margin near the posterior angle; elytral costae usually feeble or indistinct, the fourth obliterated basally, the intervals not reticulate with raised lines; anterior thoracic spiracles not prominently tubulate; and the apical angles of abdominal sternites not produced posteriorly.

The Lygistopterini have heretofore been placed last in the sequence of lycid tribes because of an elytral sculpture that departs from the normal costate and cancellate type and more nearly resembles the simply punctate sculpture of the Lampyridae. The various modifications of elytral sculpture are all derived from the same basic quadricostate pattern, and are apparently of subordinate taxonomic value to the well-defined structural differences affecting the front. On this assumption the Lycinae are divided into two categories,[1] the first containing those genera in which the front is horizontal with the mouth anterior, and comprising in the Nearctic fauna the tribes Lycini and Lygistopterini.

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[1] Trans. Amer. Ent. Soc., 1949, LXXV, p. 55.

Key to the Nearctic Genera

1. Head rostrate; mandibles small and nearly straight, not or scarcely extending beyond the clypeus, their tips distant when mandibles are closed 2

   Head not rostrate; mandibles well developed, strongly arcuate, extending beyond the clypeus, their tips overlapping when mandibles are closed 3

2. Clypeus connate with the front; dorsal pubescence long and erect, differing in the sexes; anterior coxae separated; hypomera narrow and nearly flat; tibial spurs in part rigidly attached and dissimilar **Lucaina** Duges

   Clypeus free; dorsal pubescence short and decumbent, not differing in the sexes; anterior coxae subcontiguous; hypomera rather wide and concave; tibial spurs free, similar throughout **Lygistopterus** Mulsant

3. Median longitudinal line of pronotum as in *Lygistopterus*, linear apically, thence broadly impressed, not sharply limited, widest near middle, narrowing to base ....**Adoceta** Bourgeois

   Median longitudinal line of pronotum linear, striaform throughout, sometimes partially obliterated ....**Calochromus** Guerin

LUCAINA Duges

1878. *Lucaina* Duges, La Naturaleza, IV, p. 180.
1885. *Lycaina* Horn not Duges, Trans. Amer. Ent. Soc., XII, p. 149.

Eyes small; antennae subcylindric, distant at base, fully half as long as the body in the male, vestiture short and decumbent, not dense, sparser basally, second joint elongate; front horizontal, produced in a beak; mouth anterior, mandibles small, nearly straight, arcuate apically, not extending to apex of clypeus, their tips distant when mandibles are closed; clypeus semielliptic, connate with the front, the suture convex or angulate anteriorly and sometimes more or less obliterated; palpi small, slender, terminal joint of each parallel-sided with the apex somewhat oblique. Pronotum pubescent in male, subglabrous in female; with an oblique elevation each side joining the lateral margin near the posterior angle, sides scarcely explanate; median longitudinal line not carinate at apex, more or less channeled throughout; hypomera rather narrow, nearly flat; anterior thoracic spiracles not prominent; anterior coxae distinctly separated. Elytra punctate, the costae indistinct; vestiture erect, denser in the male. Tibial spurs, except metatibial of female, dissimilar, the posterior spur of each pair stouter and apparently fixed, the anterior spur free, slender and acute.

This genus is unique in having the clypeus connate with the front, and is further remarkable for the great variety of male secondary sexual modifications, which affect many parts of the body.

Key to the Nearctic Species

Dorsal surface fulvous, elytra with a common oval black spot normally confined to apical half; pronotum usually entirely pale. Beak longer, its length about one and one-half times the distance between the eyes, evenly convex above; palpi stouter, terminal joint of each one and one-half times as long as wide; femora of male with long erect pubescence internally; dorsal surface of aedeagus finely longitudinally substrigose **discoidalis** Horn

Dorsal surface black, sides of both pronotum and elytra fulvous. Beak shorter, its length about one and one-fourth times the distance between the eyes, its upper surface usually flattened or feebly channeled basally; palpi more slender, terminal joint of each twice as long as wide; femora of male without modified pubescence; dorsal surface of aedeagus shining and nearly smooth ....**marginata** Gorham

Lucaina discoidalis Horn (Plate II, fig. 1.)

1885. *Lycaina discoidalis* Horn, Trans. Amer. Ent. Soc., xii, p. 150.

Head fulvous, usually darker posteriorly; antennae and palpi black; pronotum fulvous, often with median black spot; scutellum black; elytra fulvous with a common oval black or blue-black area in about apical half, this sometimes continuing to scutellum; ventral surface and legs black, with usually only the front and middle femora fulvous. Male with pronotum and elytra densely clothed with long fine erect cinereous pubescence, especially dense and longer on elytra, the hairs straight with their tips curved; prosternum medially, sides of mesosternum, and femora internally with similar long and dense pubescence, this less evident on metafemora; metasternum glabrous medially in both sexes; abdomen more densely pubescent medially, sparsely at the sides. Female with pronotum subglabrous; elytral pubescence usually sparse and arranged in longitudinal lines on the dark area, denser and usually inclined on the fulvous area; pubescence of ventral surface and legs short and sparse throughout. Length 5–7.5 mm.

Male.—Beak short and stout, evenly convex above, its length about one and one-half times the distance between the eyes; antennal prominence feebly elevated, narrowly divided medially. Antennae rather slender, half as long as the body, feebly compressed; basal joint longest, half as long as the beak; second joint one-half longer than wide; third narrowly triangular, nearly as long as first and over twice as long as wide; following joints parallel-sided, progressively shorter to tenth; terminal longer, oval. Palpi with terminal joints of each about one and one-half times as long as wide.

Pronotum subpentagonal, one-sixth wider than long; lateral margins nearly straight, feebly converging toward apex; median channel distinct usually in basal half. Elytra subparallel, nearly four times as long as pronotum and conjointly one and one-half times as wide; punctation irregular, usually not dense, non-setigerous.

Metasternum rather deeply longitudinally impressed in apical half; sternite 8 with a wide and shallow median sinus at apex, the margin not beveled; sternite 9 smooth and glabrous, setose apically. Tibiae distinctly arcuate, the metatibiae less strongly, not produced at apex; posterior spurs of all tibiae stout, narrowly triangular, slightly curved, broadest at base, apparently rigidly attached, shorter and nearly straight on metatibiae; anterior spurs of all tibiae nearly straight, slender and acute, movable. Aedeagus with dorsal surface of lateral lobes finely longitudinally substrigose.

FEMALE.—Antennae shorter and scarcely compressed; metasternum very feebly impressed longitudinally; sternite 8 semi-elliptic, with a triangular or trapezoidal apical notch, bottom of notch semi-membraneous; tibiae feebly arcuate, the metatibiae straight; protibial spurs as in male, mesotibial similar, the fixed spur more slender, metatibial spurs both slender, acute and free..

TEXAS: southwestern (Horn).

ARIZONA: Tucson, V–13, VI–30, VIII; Phoenix, V–8; Globe, V–16 to 25; Catalina Mts., V–11, Sabino Canyon, V–5; Salt River Mts., V–9; Sierra Ancha Mts., Gila Co., VI; Congress Jc., VI–14; Hualpai Mts., VII–4; Chiricahua Mts., VI–3.

NEVADA: Dixie N. F., VII–1.

CALIFORNIA: Providence Mts., San Bernardino Co., VI–11; Pasadena, III–20.

Lucaina marginata Gorham (Plate II, fig. 2.)

1883. *Lucaina marginata* Gorham, Biol. Cent. Amer., Coleop. III, part 2, p. 209.

Head black, beak sometimes fulvous; antennae and palpi black; pronotum black medially, the sides broadly and usually the apex narrowly fulvous; scutellum black; elytra black or blue-black with the sides fulvous, the pale area widest basally and sometimes reaching the scutellum, narrowing toward but not attaining the apex; ventral surface and legs black, the front and middle femora frequently more or less fulvous. Male with vestiture as in *discoidalis* except the femoral pubescence is unmodified and the abdomen is not more densely pubescent medially. Female with pronotum subglabrous, with few scattered decumbent short hairs; elytral pubescence long and erect, very sparse, lineate, denser only at the humeri, the lateral margins rather densely fringed with shorter hairs. Length 4.5–7 mm.

Beak slightly shorter than in *discoidalis*, its length about one and one-fourth times the distance between the eyes, median longitudinal impression of front usually continuing on basal half or more of beak in the form of a broad flattened or feebly channeled area; palpi very slender, terminal joints of each twice as long as wide; dorsal surface of lateral lobes of aedeagus not substrigose, shining and nearly smooth; structures otherwise nearly as in *discoidalis*.

TEXAS: El Paso, IV-27, on mesquite.
ARIZONA: Bumble Bee, V-20; Catalina Mts., V-11.

LYGISTOPTERUS Mulsant

1838. *Lygistopterus* Mulsant, Ann. Soc. Agr. Lyon, p. 79.

Eyes small; antennae distant at base, less than half as long as the body, densely clothed with very short prostrate pubescence; front horizontal, produced in a beak, its anterior margin truncate or very slightly advancing medially; mouth anterior, mandibles very small, feebly arcuate, scarcely extending beyond apex of clypeus, their tips distant when mandibles are closed; clypeus semi-elliptic, not connate, inserted under, but very close to, anterior margin of front; maxillary palpi small, not dilated, terminal joint triangular; labial palpi similar. Pronotum with an oblique elevation each side joining the lateral margin near the posterior angle, this sometimes indistinct; sides rather broadly reflexed, deeply concave at the hind angles, lateral margins slightly thickened; median line broadly channeled, most widely near the middle, not carinate at apex; hypomera rather wide, concave; anterior thoracic spiracles not prominent; anterior coxae subcontiguous. Elytral costae feeble, the fourth obliterated basally; intervals irregularly punctate; vestiture short and decumbent, similar in the sexes. Tibial spurs similar throughout, free, slender and acute.

Lygistopterus rubripennis Leconte (Plate II, fig. 3.)

1875. *Dictyoptera rubripennis* Leconte, Trans. Amer. Ent. Soc., v, p. 172.

Black; elytra fulvous, sometimes feebly infuscate at extreme base on either side of scutellum; scutellum black. Pubescence of elytra rather dense, fulvous, coarse, decumbent; elsewhere the vestiture is fine and sparse, especially on the abdomen; integuments shining. Beak short and stout, but little longer than the distance between the eyes; antennal prominence distinct, divided medially. Antennae slender, feebly compressed in the male; second joint short, as long as wide; third triangular, as long as first; following joints subequal to third, one-half longer than wide, subtriangular in male, nearly parallel-sided and shorter in female. Maxillary palpi small and slender, terminal joint triangular, wider than preceding; labial palpi similar, the terminal joint more broadly triangular. Pronotum subpentagonal, two-fifths wider than long, widest at base; anterior angles broadly rounded; lateral margins subparallel or feebly diverging pasteriorly to basal fifth, thence strongly diverging to the narrowly rounded posterior angles. Elytra over five times as long as pronotum and conjointly at apical third nearly twice as wide; finely punctate, the punctures poorly defined and not setigerous. Abdominal sternite 8 of male broadly and shallowly emarginate, the margin beveled medially and more densely setose; sternite 8 of female broadly semi-elliptic, sparsely clothed apically with long setae directed backward, with a small subapical sinus each side of a wide and shallow median emargination, bottom of emargination transverse and not membraneous.

Front and middle tibiae of male distinctly arcuate, slightly produced internally at apex in an acute point; posterior tibiae of male and all tibiae of female nearly straight, not mucronate. Length 10–14 mm.

COLORADO: Wet Mts., VII; Pagosa Springs, VII–1; Boulder, Jim Creek, VII–8; Cascade, VII–6.

NEW MEXICO: Jemez Mts., VI–16 to VII–27; Hot Springs, Las Vegas 7000 ft., VII; Ruidosa Creek (Fall); Gallinas Canyon (Fall).

ARIZONA: White Mts., VII–5; Alpine, 8400 ft., VI–23; Santa Catalina Mts., VI–30, VII–20, Bear Wallow, VII–13, Mt. Lemon Sta., VII–11, Mud Springs, VII–17; Chiricahua Mts., VII–12; Fort Apache, VI–16; McNary, VII–8; Greer, VII–15; Prescott; Santa Rita Mts., 5000 ft., VI–14; Sierra Ancha Mts., VII–5; Flagstaff, VII–1 to 21; Globe, VII–9; Pinal Mts., VI–18; Pinaleno Mts., VI–27; Palmerlee.

ADOCETA Bourgeois

1882. *Adoceta* Bourgeois, Abeille, xx, p. 98.

Eyes small; antennae usually distant at base, more than half as long as the body in the male, the vestiture short and prostrate, moderately dense; front horizontal, not rostrate, its anterior margin truncate or feebly advancing medially; mouth anterior, mandibles rather small, strongly arcuate, extending beyond the clypeus, their tips briefly overlapping when mandibles are closed; clypeus free, not retractile, rounded at apex, inserted under, but very near, anterior margin of front; palpi rather small, not dilated, terminal joint of each subtriangular or parallel-sided. Pronotum with an oblique elevation each side joining the lateral margin near the posterior angle; sides abruptly and rather narrowly reflexed anteriorly, sometimes throughout; lateral margins slightly thickened; median longitudinal impression as in *Lygistopterus*, linear apically, thence broad, not sharply limited, widest near middle and narrowing to base; hypomera narrow, concave; anterior coxae subcontiguous, middle coxae distant; anterior thoracic spiracles not prominent. Elytra densely and finely punctate; costae variable, the humeral obliterated basally; vestiture short, decumbent or prostrate. Tibial spurs similar throughout, free, slender and acute.

Two apparently very rare Arizona species, having the elytra fulvous and narrowly tipped with black, are assigned rather confidently to this genus. They differ from *Lygistopterus* principally in the non-rostrate head and larger arcuate mandibles which meet and briefly overlap when closed. *Calochromus* is more closely related, but appears to differ consistently from *Adoceta* in the shallow and striaform median longitudinal impression of the pronotum. Bourgeois describes the elytra of *Adoceta* as pluricostate, referring to the convexity of the intervals which are in some species equally as elevated as the four standard costae. In our two species the costae are more or less obliterated, although distinctly evident in part in *A. ignita.*

Key to the Nearctic Species

Pronotum black with the sides fulvous ....**ignita** new species
Prontoum entirely black ....**apicalis** new species

Adoceta ignita new species (Plate II, fig. 4.)

1885. *Lygistopterus laetus* Horn not Gorham, Trans. Amer. Ent. Soc., xii, p. 149.

Form narrowly elongate, widening posteriorly to apical fourth. Black; elytra except apical eighth, sides of pronotum, hypomera, and mandibles fulvous; scutellum black. The fulvous pronotal borders occupy about one-sixth the total width each side. Pubescent above and beneath; vestiture of head and pronotum fine, not dense, prostrate; elytral pubescence coarse, short and dense, prostrate, fulvous except on black area; ventral pubescence decumbent, sparse except on abdomen. Length 7–11 mm.

Male.—Antennal prominences distinctly elevated, separated by a narrow impression; front not descending, somewhat produced, extending before the eyes a distance, excluding clypeus, equal to one and one-third times the length of an eye, anterior margin truncate; mandibles rather straight basally, strongly arcuate apically, very briefly overlapping; clypeus prominent, semielliptic. Antennae moderately distant at base, slender, feebly compressed, two-thirds as long as the body, densely and finely punctate, more densely in apical half or more, without interspersed coarse punctures; first joint rather slender, feebly obconic, second small and as long as wide, third narrowly triangular, as long as first and twice as long as second, fourth and fifth each one-half longer than third, slightly wider to apex, joints 6 to 10 each about twice as long as wide, diminishing distally in length and width, their inner apical angles feebly produced internally, terminal joint narrowly rounded at tip, sinuate within near apex. Terminal joint of maxillary palpus rather broadly triangular, twice as wide as third joint, moderately compressed, apex arcuate and oblique, longer than inner side; labial palpi similar.

Pronotum subpentagonal, widest at base, three-tenths wider than long; lateral margins feebly converging from base to middle, thence a little more strongly and arcuately to the feebly indicated and broadly rounded anterior angles, posterior angles rather narrowly rounded; sides distinctly reflexed throughout, not interrupted by the oblique elevations, these very feeble, sinuate, the inner half transverse.

Elytra over four and one-half times as long as pronotum and conjointly at apical fourth one and one-half times as wide; surface finely and densely punctulate, sutural bead basally and first two discal costae distinctly elevated, third costa faint, fourth nearly obliterated.

Abdominal sternite 8 emarginate in median fifth, the emargination one-half wider than deep, sides diverging posteriorly, bottom transverse, not beveled; sternite 9 as wide as the notch of sternite 8, concave and glabrous medially, sides and tip pubescent. Legs comparatively stout; protibiae nearly straight, mesotibiae distinctly arcuate, metatibiae the most slender, feebly arcuate; tibial apices unmodified.

FEMALE.—Differs from the male in having the antennae shorter and stouter, the median joints about one and one-half times as long as wide with their inner apical angles not produced; sternite 8 semi-elliptic, with a moderately large triangular apical notch, bottom of notch rounded, not membraneous; tibiae all nearly straight. The antennae are without distinct coarser punctures such as are found in the female of *Adoceta apicalis.*

Holotype.—Male; Arizona, Horn collection; located in collection of Academy of Natural Sciences of Philadelphia.

Allotype.—Female; same data and location as holotype.

Paratypes.—ARIZONA: no definite locality, two males in the Horn collection, and two males in the Bolter collection at the Illinois State Natural History Survey.

This species was given the cabinet name *"Lygistopterus ignitus"* by Leconte, and was subsequently identified by Horn as *Lygistopterus laetus* Gorham. Gorham described *laetus* from Panama, associating tentatively with it two smaller mutilated specimens collected in northern Sonora. The latter were very probably examples of *Adoceta ignita.* According to Gorham's figure and description,[2] *laetus* is a larger insect, 12 to 15 mm. in length, the apical elytral spot is more extensive, there is in addition a common triangular sutural spot at the base of the elytra, and the tibiae of the male are mucronate. The tibial apices are unmodified in both sexes of *ignita.*

Adoceta apicalis new species

Form narrowly elongate, subparallel. Black; elytra fulvous with apical tenth black, scutellum black. Pubescence of elytra not dense, fulvous except on black area, rather coarse, short and decumbent; elsewhere the vestiture is fine and sparse, a little denser on the head, the integuments smooth and shining. Length 6.5–8.25 mm.

FEMALE.—Antennal prominence feebly elevated, divided posteriorly by a linear impression, more widely separated in front; front short, extending before the eyes a distance, excluding clypeus, equal to two-thirds the length of an eye, anterior margin truncate; mandibles regularly arcuate, briefly over-

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[2] Biol. Cent. Amer., 1883, Coleop. III, part 2, p. 227.

lapping; clypeus transverse. Antennae moderately distant at base, slender, feebly compressed, less than half as long as the body, uniformly finely punctate, with coarse shallow punctures along inner side of the segments, the coarse punctures more numerous distally; first joint feebly obconic, second small, as long as wide, third triangular, twice as long as second and nearly as long as first, fourth as long as two and three combined, with subparallel sides diverging only slightly from base, following joints similar to fourth, shorter, about one and one-half times as long as wide, terminal joint narrowly rounded at tip. Maxillary palpi with terminal joint not wider than preceding, one-half longer than wide, sides subparallel, apex oblique with the inner apical angle broadly rounded; terminal joint of labial palpus similar.

Pronotum subpentagonal, one-fourth wider than long, lateral margins subparallel, anterior angles rather broadly rounded, posterior angles narrowly; sides distinctly reflexed in front, region of hind angles deeply concave; oblique elevations distinct, sinuate, inner half transverse.

Elytra over five times as long as pronotum and conjointly at apical third one and one-half times as wide; surface finely and rather densely rugulose-punctate, the punctures formed by the surface irregularity and not setigerous; costae very faintly indicated. Sternite 8 semi-elliptic, apex triangularly emarginate, the notch partly closed by membrane; tibiae straight, the apices unmodified.

MALE.—Unknown.

Holotype.—Female; Santa Catalina Mts., Arizona, July, 1936, collected by E. S. Ross at Soldier's Camp, elevation 7500 to 8000 feet; located in collection of California Academy of Sciences.

Paratypes.—ARIZONA: S. Catalina Mts., VI–30, one female in collection of American Museum of Natural History; Mt. Lemon, S. Catalina Mts., VII–27, two females in collection of Cornell University.

CALOCHROMUS Guerin

1833. *Calochromus* Guerin, Ann. Soc. Ent. France, p. 158.

Eyes small; antennae slender, subcylindric or feebly compressed, distant at base, slightly over half as long as the body in the male, rather densely clothed with short prostrate pubescence, second joint not transverse; antennal prominence very feeble or lacking, usually with a distinct linear longitudinal impression between the eyes, front horizontal, not rostrate, its anterior margin somewhat advancing medially over base of clypeus and usually similarly prominent each side, forming a triundulate outline; mouth anterior, mandibles strongly arcuate, extending beyond the clypeus, their tips overlapping when mandibles are closed; clypeus not prominent, inserted far under anterior margin of front and more or less retractile, the exposed part transverse, rounded at apex; maxillary palpi small, not dilated, terminal joint subtriangular or parallel-sided; labial palpi similar. Pronotum with an oblique elevation each side joining the lateral margin near the posterior angle; sides not explanate or reflexed, lateral margins much thickened; median longitudinal impression shallow and very narrow, striaform, usually entire; vestiture prostrate; anterior thoracic spiracles not prominent; anterior coxae contiguous. Elytra punctate or finely rugulose, costae feeble or lacking, pubescence prostrate. Ventral surface smooth and shining, very sparsely punctate and pubescent. Tibiae nearly straight, apices unmodified in the male; spurs similar throughout, free, slender and acute.

Several exceptions must be made to the above definition when the exotic species of *Calochromus* are considered. These exceptions involve the separation, form, and vestiture of the antennae; structure of the palpi; outline of the anterior margin of the front; and reduction of the pronotal sculpture. In some species the front extends medially over the clypeus in an abrupt truncate process, the clypeus being concave or grooved for its reception. Whether these deviations are to be regarded as of generic importance, or simply as indications of taxonomic divisions of a single widely distributed genus, is a question that cannot be answered in the study of a restricted fauna. The Nearctic species are accordingly retained in the genus *Calochromus.*

Secondary sexual modifications of the abdominal apex are similar for all the Nearctic *Calochromus.* Sternite 8 of the male is arcuately and rather deeply emarginate in median third or fourth, the emargination preceded by a crescentic beveled area which is usually sharply limited each side; sternite 9 is smooth, shining, and glabrous at base, setose apically. Sternite 8 of the female is subtriangular or semi-elliptic, sparsely clothed apically with longer setae directed posteriorly, the apex with a wide shallow emargination, the bottom of which is transverse and not membraneous.

Key to the Nearctic Species

1. Pronotum trapezoidal or subpentagonal, narrowed in front; elytral costae feeble but evident; antennae subserrate and distinctly longer in the male; front more elongate before the eyes, gradually descending to the level of the clypeus. Black, sides of pronotum fulvous ...... **perfacetus** Say
Pronotum shorter, subrectangular, scarcely narrowed in front; elytral costae indistinct or obliterated; antennae nearly similar in the sexes, not subserrate; front very short before the eyes and convexly descending ..2
2. Elytra unicolorous 3
Elytra fulvous with apical half black 4

3. Black, pronotum fulvous .... **ruficollis** Leconte
   Black, pronotum and elytra fulvous, the former with a transverse posterior dusky spot .... **fervens** Leconte
4. Pronotal vestiture fine, not dense, not concealing the surface; elytra black in usually more than apical half, anterior margin of black area oblique, extending nearest to base at suture .... **dimidiatus** Leconte
   Pronotal vestiture dense and rather coarse, partly concealing the surface; elytra black in usually less than apical half, anterior margin of black area transverse .... **slevini** Van Dyke

Calochromus perfacetus Say (Plate II, fig. 5.)

1825. *Lycus perfacetus* Say, Amer. Ent., II, p. 21.
1851. *Dictyopterus substriatus* Leconte, Jour. Acad. Nat. Sci. Phila., 2nd series, I, p. 74.

Black, sides of pronotum fulvous. Leconte cites var. a from Texas as having the pronotum entirely fulvous. Sparsely pubescent above; vestiture longer and denser on pronotum; shorter, dark, and inconspicuous on elytra. Front somewhat elongate before the eyes, gradually descending to the level of the clypeus; antennae of male compressed, subserrate, second joint as long as wide, following joints elongate, narrowly triangular, inner apical angle of joints 5 to 10 slightly produced anteriorly, distal half or more of antennae densely opaque and without apparent punctation, the vestiture very short and dense; antennae of female shorter, feebly compressed, not subserrate, distal half not opaque, with evident but poorly defined coarse shallow punctures; terminal joint of maxillary palpus subtriangular, wider than preceding joint. Pronotum trapezoidal or subpentagonal, widest at base, less than one-half wider than long, lateral margins nearly straight, converging from base to the rather broadly rounded anterior angles, posterior angles narrowly rounded; elytra over five times as long as pronotum and conjointly at apical third one and one-half times as wide, surface dull except at base, very finely and densely rugose-punctate; costae evident but feeble. Length 6–10.5 mm.

Distribution: Ranges from Massachusetts south to Florida and west to Michigan (Wexford), Wisconsin, Arkansas (South West), Texas (Austin, Willis), and New Mexico (Beulah—Fall).

Calochromus ruficollis Leconte (Plate II, fig. 6.)

1875. *Dictyoptera ruficollis* Leconte, Trans. Amer. Ent. Soc., v, p. 172.

Black, pronotum fulvous, scutellum black, elytra slightly blue-black. Sparsely pubescent above, vestiture longer and denser on pronotum. Form and structure nearly as in *perfacetus*, front shorter before the eyes and convexly descending to the clypeus; antennae subcylindric, nearly similar in the sexes, not serrate, densely opaque and indistinctly punctate distally in the male; terminal joint of maxillary palpus parallel-sided, not wider than preceding, slightly stouter in female; pronotum subrectangular, one-half wider than long, anterior margin broadly rounded, lateral margins subparallel, only very feebly converging in front; elytra feebly shining, finely and densely rugose-punctate, smoother basally, pubescence dark and inconspicuous, costae nearly obliterated. Length 7–9.5 mm.

ARIZONA: Aspen Springs, 9400 feet, VIII–10; McNary, VIII–12; White Mts., VIII–12.

NEW MEXICO: Rio Arriba County, VIII–13; Las Vegas; Jemez Mts., VII–3, IX–2; Magdalena Mts., VIII–9; Gallinas Canyon (Fall); Sante Fé Canyon (Fall); Beulah (Fall); Eagle Creek (Fall).

COLORADO: (Leconte).

OREGON: (Leconte).

Calochromus fervens Leconte

1881. *Calochromus fervens* Leconte, Trans. Amer. Ent. Soc., IX, p. 28.

Black, pronotum and elytra fulvous, the former with transverse black or dusky spot between the oblique elevations, this sometimes extending forward along median line; scutellum black. Dorsal vestiture less sparse and more conspicuous than in *ruficollis*, not denser on pronotum. Form and structure nearly as in *ruficollis*; terminal joint of maxillary palpus subtriangular, wider than preceding; elytra not rugose, finely and densely punctulate, striate with rows of larger irregularly spaced punctures, these obsolete at sides and base; male genitalia similar to *perfacetus*. Length 8–9 mm.

SOUTH DAKOTA: Hill City, VI–6.

COLORADO: Pingree Park, VIII–18.

OREGON: Sparta, Baker County, VII–2.

BRITISH COLUMBIA: Rolla, VII–2; Midday Valley, VI–25.

Calochromus dimidiatus Leconte (Plate II, fig. 7.)

1875. *Dictyoptera dimidiata* Leconte, Trans. Amer. Ent. Soc., V, p. 172.

Black, pronotum and elytra fulvous, elytra blue-black in apical half with the anterior margin of the black area oblique, extending nearest to base at the suture; scutellum black. Sparsely pubescent above, vestiture longer and denser on pronotum but not concealing the surface. Form and structure nearly as in *ruficollis*; antennae not densely opaque distally, somewhat shining throughout in both sexes; terminal joint of maxillary palpus parallel-sided, not wider than preceding, slightly more robust in female; fulvous area of elytra rather smooth and shining, finely punctulate, black area rugose-punctate and more sparsely pubescent. Length 7–10 mm.

CALIFORNIA: Portola, IX–5; Siskiyou, IX; Shasta, VII; Lassen County, Norvall Flats, 5000 feet, IX–1.

NEVADA: Kyle Canyon, Clark County, VII–25; Reno, VIII–11.

IDAHO: Yale, IX–10.

WASHINGTON: "W.T." (Horn collection).

Calochromus slevini Van Dyke

1918. *Calochromus slevini* Van Dyke, Bull. Brook. Ent. Soc., XIII, p. 1.

Black, pronotum and elytra fulvous or rufous, elytra black in usually less than apical half with the anterior margin of black area squarely transverse; scutellum black. Very similar to *dimidiatus*, pronotal vestiture coarser and denser, nearly concealing the surface; elytra less shining, the sculpture and vestiture somewhat denser. Length 8–10 mm.

CALIFORNIA: Mt. Hamilton, V–6; Gilroy Hot Springs, X–17; San Antonio Canyon, X; Marsh Creek, IX; Little Rock, Mojave Desert, X–20; Alum Rock Park, Santa Clara County, XI–2. Black Mountain, Santa Clara County, X–19; Mt. Diablo, Contra Costa County, III–12; Pasadena, X–7.

EXPLANATION OF FIGURES

PLATE II

The letters a, b, and c signify, respectively, dorsal, lateral, and ventral aspects.

Fig. 1.—*Lucaina discoidalis* Horn, male genitalia, Yavapai County, Arizona, VI–8–41, F. H. Parker.

Fig. 2.—*Lucaina marginata* Gorham, male genitalia, El Paso, Texas, IV–27–27, J. O. Martin.

Fig. 3.—*Lygistopterus rubripennis* Leconte, male genitalia, Jemez Mts., New Mexico, VI–16, John Woodgate.

Fig. 4.—*Adoceta ignita* new species, male genitalia, Arizona.

Fig. 5.—*Calochromus perfacetus* Say, male genitalia, Wind Gap, Pennsylvania, VII–2–30, J. W. Green.

Fig. 6.—*Calochromus ruficollis* Leconte, male genitalia, White Mts., Arizona, VIII–12–39, F. H. Parker.

Fig. 7.—*Calochromus dimidiatus* Leconte, male genitalia, Siskiyou County, California.

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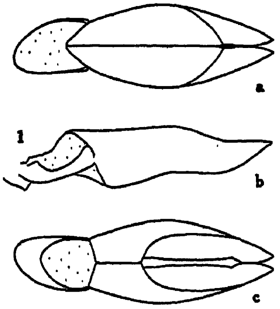

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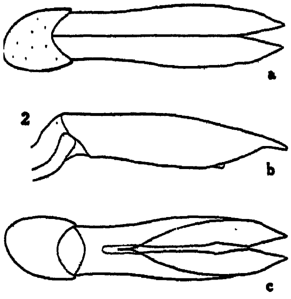

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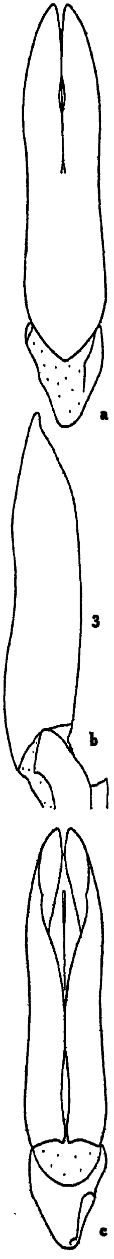

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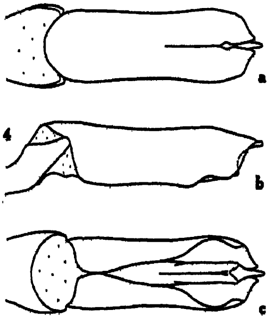

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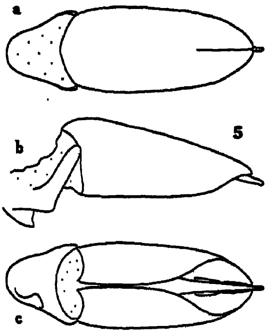

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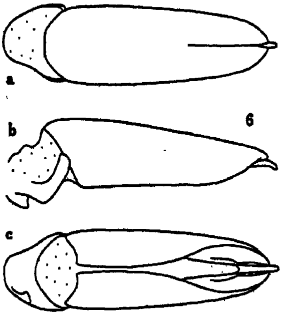

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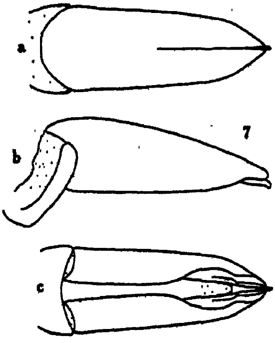

GREEN—LYCIDAE OF UNITED STATES AND CANADA

REVISION OF THE ANT TRIBE DACETINI: II. GLAMYROMYRMEX Wheeler AND CLOSELY RELATED SMALL GENERA[1]

BY WILLIAM L. BROWN, JR.

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(Text-figures)

Included in *Glamyromyrmex* Wheeler are a handful of small, little-known short-mandibulate dacetines of the *Smithistruma* subcomplex. In my 1948 revision (*op. cit., infra*) I included *beebei* Wheeler, *wheeleri* M. R. Smith, and *convexiceps* (Santschi) in this group and defined the genus on the basis of the worker. That definition must now be enlarged to include the new subgenus *Chelystruma* described below.

G. (*Chelystruma*) *lilloana* new species proves to be a primitive form connecting *Glamyromyrmex* with the other members of the *Smithistruma* subcomplex. The affinities with *Smithistruma* seem to run through a series of genera (*Codiomyrmex* Wheeler, *Weberistruma* Brown) which are old and have become distinct in their own right. *Glamyromyrmex* and the two related monotypic genera *Codioxenus* Santschi and *Dorisidris* Brown represent an extreme development of this old line in which the usual densely punctulate sculpture of the majority of higher dacetines has given way to an almost or quite smooth and shining surface on head and alitrunk as well as on the gaster. This change has been accompanied by a shortening and broadening of the head, the lateral expansion largely due to development of the sublamelliform roof of the antennal scrobe on each side. Due to this development and to other changes, the flattened-pyriform shape so characteristic of most dacetines is largely lost. The mandibles have become shortened and thickened, and in all species but *lilloana*, the teeth are reduced in number from the *Smithistruma* pattern and individually enlarged.

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[1] Part I of this series, on the dacetine fauna of Japan, China and Taiwan, appeared in Mushi, vol. 20, pp. 1–25, 1949.

Glamyromyrmex is a New World genus which has produced, but in a much more modest way, aberrant daughter genera with developments paralleling those of the Old World *Smithistruma* derivatives *Miccostruma* Brown and *Epitritus* Emery. A similar process seems to have taken place in both *Miccostruma* and *Codioxenus,* causing them to lose the small segments II and III of the antennal funiculus present in their respective parent genera. In like fashion, *Dorisidris* and *Epitritus* have been developing secondarily *Strumigenys*-like mandibles through slight lengthening, and loss and reduction of the serially arranged dentition of *Glamyromyrmex* and *Smithistruma* respectively.

Since the species listed here have for the most part been satisfactorily described and figured by the original authors, I shall not do more than list the references and a few comments where such seem necessary. It should be remembered in accepting measurements of previous authors that the total lengths given are not equivalent to those given in the present revision. All "total lengths" given here are determined by measuring separately the main axial lengths of head and mandibles, alitrunk, petiole, and postpetiole-gaster and adding these values together. This method gives the maximum outstretched length of the insect, and seems to afford the only escape from the hopelessly non-standard and inaccurate measurements made by some former authors. I believe that these older measurements are all too low. For explanation of measurements and indices, see my Part I of this revision (1949, Mushi, XX, p. 2).

The following abbreviations are used for institutions containing type material: [Santschi Coll.] Santschi Collection, Basle Museum, Switzerland. [MCZ] Museum of Comparative Zoology, Cambridge, Massachusetts. [USNM] United States National Museum, Washington, D. C.

Recognition

The members of the *Glamyromyrmex* group of genera may be distinguished from other "short-mandibulate" genera of the *Strumigenys* complex by their short, non-pyriform heads and especially by the more or less smooth, shining integument of the head and alitrunk and the extremely reduced and scanty pubescence-like pilosity of at least the anterior part of the head. The size of all the species is small or very small, and the usual color is a dark ferrugineous to blackish-brown. All the known species are restricted to the Neotropical region, and all seem to be dwellers in the soil or soil cover. The food probably consists of the juices of small, cryptobiotic arthropods, but in view of the reduced pilosity and shining integument, it cannot be assumed that the habits are exactly those of *Smithistruma.*

Key to the Genera

1. Mandibles elongate-sublinear; inner borders near the apex with a few separated spiniform teeth ....**Dorisidris** Brown
   Mandibles shorter, subtriangular; inner borders serially dentate 2
2. Antennal funiculus 3-segmented ....**Codioxenus** Santschi
   Antennal funiculus 5-segmented ....**Glamyromyrmex** Wheeler

DORISIDRIS Brown

Dorisidris nitens (Santschi)

Strumigenys (*Codiomyrmex*) *nitens* Santschi, 1932, Revista de Ent., II, pp. 413–414, fig. 2, worker.

Dorisidris nitens Brown, 1948, Trans. Amer. Ent. Soc., LXXIV, pp. 116–117.

This species may be recognized by the oblong, straight-sided head and especially by the elongate, somewhat *Labidogenys*-like mandibles. There is apparently present a rounded basal lamella to the mandible, partly hidden under the clypeus. This form is known only from a single worker, the holotype, deposited in Santschi Coll.

Type locality.—Sierra del Rosario, Pinar del Rio, Cuba (A. Bierig). Genotype and only known species.

CODIOXENUS Santschi

Codioxenus simulans Santschi

Epitritus (*Codioxenus*) *simulans* Santschi, 1931, Revista de Ent., I, pp. 278–279, figs. 11, 12, worker.

Codioxenus simulans Brown, 1948, Trans. Amer. Ent. Soc., LXXIV, p. 123.

This species is superficially very similar to *Glamyromyrmex convexiceps* (Santschi), which came to the original author mixed with it in the same vial. Santschi thought that this signified some parasitic or other relationship between the two species. Closely related species of dacetines so often occur accidentally together, however, that we must wait for proof of Santschi's hypothesis by a direct observer. Known only from the type collection: 2 workers taken at Playa Marianao, Habana, Cuba (A. Bierig), deposited Santschi Coll. Genotype and only known species of the genus.

GLAMYROMYRMEX Wheeler

Glamyromyrmex Wheeler, 1915, Bull. Mus. Comp. Zool. Harvard, LIX, pp. 487–488, worker, female, male. Emery, 1922, Gen. Ins., Fasc. 174, p. 326. M. R. Smith, 1944, Proc Ent. Soc. Washington, XLVI, pp. 254–256. Brown, Trans. Amer. Ent. Soc., LXXIV, p. 116.

Strumigenys (Codiomyrmex) Santschi, 1931, Revista de Ent., I, p. 277, part (not *sensu* Emery 1922).

Codiomyrmex Weber, 1934, Revista de Ent., IV, p. 52, part (not *sensu* Wheeler 1916).

WORKER.—With the characters as mentioned above under "Recognition," with the additional qualifications of five-segmented funiculi and subtriangular, serially dentate mandibles. The apical funicular segment is usually if not always equal to or shorter than the remainder of the funiculus. The workers in the genus are quite different from one another, and though there are only four known species, general characterization is difficult.

FEMALE.—Known from only one species (*beebei* Wheeler), and there showing a considerable difference in the shape of the head compared to the accompanying workers. The head shape in this female is more like that of *wheeleri* M. R. Smith than like that of its own worker, but other details of body structure show that Wheeler was probably correct in assigning the two castes to the same species. This species shows a stronger difference between the female and worker castes than does any other species of dacetine ant known at present. It will be interesting to see, once the females of the other species are known, whether a similar difference is present throughout the genus.

MALE.—Wheeler characterized the male of one species, *beebei*; this proved to be much like those of other *Strumigenys* complex genera. The mandibles show an obtuse angle separating basal and apical borders, but toothless; apex acute. The sculpture is much like that of *Smithistruma* species. Wings (in both sexes) much like those of related genera; forewing with distal venation and *Rs* + *M* aborted; most of *M* + *Cu* lost, represented distally by a recurrent spur; *A* passing through a curve into *cu-a*, which in turn runs into the "basal vein" at the point where the recurrent spur comes off. The genitalia of *beebei* are shown in fig. 2.

GENOTYPE: *Glamyromyrmex beebei* Wheeler (Monobasic).

The four species included in the genus are strikingly different one from another—in fact, the differences are so great that one could consider each the genotype of a separate genus or subgenus. I have separated the single new form, which seems more primitive and distinct from the group as a whole, as a new subgenotype. Not only does this arrangement emphasize relationships within the group, but it makes allowance for the almost certain future discovery of forms intermediate between presently known species. More extensive collecting in the New World tropics, especially Berlese funnel sifting, may be expected to greatly increase the number of species in *Glamyromyrmex*.

Subgenera (characterizations based on workers)

Glamyromyrmex *sensu stricto*

Anterior clypeal border transverse, concave or emarginate. Mandibles robust, usually short and with modified dentition, the teeth reduced in number and individually enlarged compared to the typical pattern seen in *Smithistruma*. Basal lamella more or less distorted compared to that of *Smithistruma*, but apparently present in some form in all the species. Alitrunk and nodes of abdominal pedicel not strongly depressed dorsally or with strong, sharp dorsolateral margins.

Subgenotype as for the genus.

Contains three known species which can be arranged in a series according to specialization away from the pattern shown by the other, probably more primitive, subgenus and species, *G.* (*Chelystruma*) *lilloana*. Of this series, *G.* (*G.*) *beebei* seems to be the most aberrant and *G.* (*G.*) *convexiceps* the least; *wheeleri* appears intermediate between the two last-named species.

Key to the Known Species of Glamyromyrmex sensu stricto: Workers

1. Anterior clypeal border deeply and rather narrowly excised in the middle; petiolar node seen in profile very low and gently rounded (Amazon Basin) .... **beebei** Wheeler
   Anterior clypeal border transverse or shallowly and very broadly excised; petiolar node seen in profile forming a raised, narrowly rounded or subangular peak 2
2. Anterior clypeal border shallowly and broadly excised; posterior dorsum of head without erect hairs (Panama) ....**wheeleri** M. R. Smith
   Anterior clypeal border transverse, approximately straight; posterior dorsum of head with a few erect hairs (Cuba)
   convexiceps (Santschi)

Glamyromyrmex (Glamyromyrmex) beebei Wheeler (Figure 2.)

Glamyromyrmex beebei Wheeler, 1915, Bull. Mus. Comp. Zool. Harvard, LIX, pp. 488–491, fig. 2, worker, female, male. Emery, 1922, Gen. Ins.. Fasc. 174, p. 326. M. R. Smith, 1944, Proc. Ent. Soc. Washington, XLVI, pp. 254, 256. Brown, 1948, Trans. Amer. Ent. Soc., LXXIV, p. 116.

WORKER.—Well described and figured by Wheeler. Three worker types were remeasured.[2] Total length 1.85–2.26 mm., head length 0.54–0.61 mm., cephalic index 67–71, mandibulo-cephalic index 10.

Mandibles very short, convex and oriented almost dorso-ventrally. Basal mandibular border partially filled in by a broad crescentic translucent lamella which is the proximal extension of the basal lamella. Apical series of teeth eight in number, stout; teeth 1 and 2 (counting from base toward apex, basal lamella, of course, excluded) showing a bicuspid tendency in each, the rest long and acute, increasing gradually in length to tooth 5, which is the longest, and then decreasing toward the apex. The basal tooth or lamella fairly distinct from the apical series, with an oblique, chisel-like cutting edge.

Head seen from above with sides concave at the midlength. Dorsal surface of head convex in both directions to the clypeus, which slopes rather abruptly anteriorly, giving the head an appearance somewhat like that of certain ants (*Colobopsis*) which use the head to block the nest entrance. No erect hairs on cephalic dorsum.

FEMALE.—Total length 2.60–2.82 mm., head length 0.70–0.75 mm., cephalic index 92–95, mandibulo-cephalic index 14–16. Mandibles and anterior clypeal border much as in the worker, but head much broader and without concavity of the lateral borders; general shape more like that of *wheeleri* worker.

MALE.—Total length 2.0–2.1. Genitalia shown in fig. 2.

Type locality.—Pará [Belém], Brazil (W. Beebe). This is the only known record. Beebe removed the type series from jungle mould under a tree on the outskirts of Belém. In the same sample were numerous Collembola and 16 other species of ants, including a dealate female of *Strumigenys* (*Pyramica*) *subedentata* Mayr. Food is unknown, but springtails are the suspected prey. Most of the type series presently rests in the MCZ, while other type specimens are in the USNM.

Glamyromyrmex (Glamyromyrmex) wheeleri M. R. Smith

Glamyromyrmex wheeleri M. R. Smith, 1944, Proc. Ent. Soc. Washington, XLIV, pp. 254–256, figs. 1, 2, worker. Brown, 1948, Trans. Amer. Ent. Soc., LXXIV, p. 116.

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[2] See note on measurement in introduction to this part. All indices on

WORKER.—Measured from a paratype: total length 2.10 mm., head length 0.52 mm., alitrunk length 0.54 mm., cephalic index 96, mandibulo-cephalic index 17.

Only the worker is known, and this has been very expertly described and figured by Smith. I would disagree with his measurement of the length, which is low if the system of measurements used in this revision is followed: "Length 1.6 mm.", according to the original description. No erect hairs on the dorsum of the head. Subocular ridges each ending anteriorly with an acute, ventrally directed tooth, which is found also in an undescribed African *Codiomyrmex* and is therefore probably a character of some phylogenetic significance. Pronotum feebly submarginate.

Originally described from the holotype [USNM No. 56903] and an additional paratype worker, taken on Barro Colorado Island, Panama Canal Zone (J. Zetek). These are the only specimens reported to date. The species is probably a dweller in the soil cover. Paratype in MCZ.

Glamyromyrmex (Glamyromyrmex) convexiceps (Santschi)

Strumigenys (Codiomyrmex) convexiceps Santschi, 1931, Revista de Ent., I, p. 277, figs. 9, 10, worker.

Codiomyrmex convexiceps Weber, 1934, Revista de Ent., IV, p. 52.

Glamyromyrmex convexiceps Brown, 1948, Trans. Amer. Ent. Soc., LXXIV, pp. 115–116.

WORKER.—The length Santschi gives ("1.6 mm.") is probably a little too small. The sides of the head are gently convex, slightly convergent anteriorly. The clypeus is broadly triangular, with an approximately straight anterior border and narrowly rounded lateral angles. The mandibles are robust and anteriorly projecting with "6 or 7" teeth, the basalmost probably being the basal lamella. There are two or three pairs of erect hairs on the extreme occiput, a few on the thorax, petiole and postpetiole, all slender. Color "deep brown."

Known only from the three cotype workers, Santschi Coll. Type locality: Playa Marianao, Habana, Cuba (A. Bierig). Mixed in the original collector's vial were workers of the superficially similar *Codioxenus simulans*.

Chelystruma new subgenus

WORKER.—Characters as in *Glamyromyrmex* s. str., except for the following differences:

1. Anterior clypeal border convex and projecting.
2. Mandibles robust and convex, but with dentition as in *Smithistruma*: basal lamella and 12 teeth in the apical series (7 principal teeth, 4 denticles, and an acute apical tooth).
3. Alitrunk, including pronotum, and nodes depressed and with strong dorsolateral margins.

GENOTYPE: *Glamyromyrmex* (*Chelystruma*) *lilloana* new species.

Glamyromyrmex (Chelystruma) lilloana new species (Figure 1.)

HOLOTYPE WORKER.—Total length 1.91 mm., head length 0.51 mm., alitrunk length 0.47, cephalic index 98, mandibulo-cephalic index 19. Maximum width of pronotum 0.34 mm.

Head broad shield-shaped, broadest at about the posterior third, dorsal surface gently convex in both directions; posterior excision broadly arcuate, rather shallow. Dorsolateral borders of the head broadly extended and overhanging the deep antennal scrobes. Eyes small, consisting of less than a dozen facets, situated a little behind the midlength of the head astride the ventral borders of the scrobes. Subocular lamina without a tooth anteroventrally.

Antennae short; scapes very faintly S-shaped, a bit more than half as long as the funiculi, slender basally and with the distal ⅔ moderately incrassate, broadest at about the midlength; funiculus short and thick as in other *Glamyromyrmex* and related genera, the apical segment equal in length to the remainder of the funiculus; segments I and IV subequal, but the latter much the broadest; II and III subequal, together approximately equalling IV.

Clypeus ⅕ broader than long, weakly convex, its anterior apron projecting and convex, forming a blunt, rounded obtuse angle in the middle anteriorly. Mandibles stout, convex, strongly projecting and apically arched ventrad; outer borders convex in outline. Basal lamella translucent, fairly narrowly rounded, proximal border sloping gently, distal border dropping abruptly to meet the base of the first tooth of the apical series without a diastema intervening; base of lamella about as broad as the space occupied by the first three teeth of the apical series. Apical series of the typical *Smithistruma* pattern, with 7 long, acute teeth, tooth 3 longest, 4–7 decreasing in length; four rather irregularly fused, subacute denticulae, followed by the long, acute apical tooth, which is about as long as tooth 3 of the principal apical series. At full mandibular closure, opposing apical teeth cross, each projecting laterally for some distance.

Alitrunk with strongly depressed and very sharply marginate dorsum, seen in profile evenly and gently arched from the anterior pronotal border to the posterior mesonotal border. Pronotum broadest anteriorly, ⅔ as broad as the head; anterior border rounded, cultrate, lateral margins sharp, overhanging the sides, humeral angles bluntly rounded. Mesonotum broad-oval, about half as wide as the pronotum; promesonotal suture obscure, arcuate; posterior mesonotal border subtruncate, raised slightly above the short, posteriorly sloping dorsal surface of the propodeum. Seen from above, the mesonoto-propodeal constriction strong. Propodeal dorsum short and narrow, continuing the lateral margins onto the propodeal teeth. These teeth diverging behind, lamellate, compressed, about half as long as their interbasal distance; seen from the side acute, translucent, with straight horizontal dorsal borders, continued below as translucent infradental lamellae, each of which widens below to form an angular ventral tooth or plate.

Petiolar peduncle fairly long; posterodorsal disc flattened, marginate anteriorly and laterally, twice as broad as long, with weakly convex surface, the anterior border straight and forming a rather sharp summit if viewed from the side. Sides of node converging behind and each giving rise to a broad, thin, clear, leaf-like lamelliform lobe directed laterally, posteriorly, and deflected a bit below the horizontal, apex narrowly rounded. A band of this same subspongiform material running medially along the midventral line of the petiolar peduncle. Postpetiolar node subrectangular, the posterior border rounded, almost twice as broad anteriorly as long and about ⅓ again as broad as the petiolar node, dorsal surface rather strongly convex; completely surrounded by a thin, vesiculate lamelliform or subspongiform horizontal extension much like the appendages of the petiole in consistency, the transverse anterior border narrow, the lateral lobes sweeping posteriorly and broadening to the anterolateral gastric margins where each ends in an acute apex. Postpetiole below with luxuriant festoons of subspongiform tissue, which meet a spongiform pad on the anteroventral gastric surface. Gaster broad-oval, somewhat depressed above; anterior border transverse, bordered by a thin sinuate lamella. First gastric sternite on each side weakly impressed or concave anteriorly; dorsolateral borders of the first gastric tergite bluntly marginate along the anterior half.

Body in general smooth and highly shining; with very feeble, dilute subreticulation on the cephalic dorsum and weak indications of longitudinal striation on the alitrunk dorsum which do little to interfere with the high polish of the integument. Propodeum, especially the declivity, transversely striate. Basal gastric costulae straight, rather fine and long, extending about half the length of the first gastric tergite, radiating from bilateral sources, with a smooth, narrow median space between the two bundles smooth and shining, as is the remainder of the gastric surface. Legs shining, but antennae and mandibles weakly and densely punctulate, only feebly shining.

Erect pilosity scanty, consisting of erect, straight or slightly curved bristle-like hairs: one pair on the occiput, a pair of curved ones on the humeral angles, three straight ones on each dorsolateral promesonotal margin, a few on the dorsal surfaces of each node, and a more abundant, but still sparse, growth on the gastric dorsum, where they are longest and straightest on the posterior dorsum.

Except for the erect occipital pair, the dorsal cephalic pilosity is reduced to a dilute and very inconspicuous pubescence, closely appressed and anteromedially directed, coarser on the posterior clypeus and becoming very fine and dense along the anterior clypeal border. Legs with abundant, rather long, stout subreclinate hairs; antennae and mandibles densely clothed with short, fine appressed hairs.

Color dark brown; petiole and postpetiole lighter and more yellowish, legs and antennae sordid yellow, appendages of petiole and postpetiole yellowish, of ventral surface of gaster, more whitish.

Holotype worker, with the four paratypes described below, taken in the garden of the Instituto Miguél Lillo, Tucumán, Argentina. Holotype and two paratypes to be returned to Dr. Nicolás Kusnezov, the collector of these specimens, for inclusion in the collections of the Instituto on whose grounds they were taken. Remaining two paratypes deposited in MCZ and USNM.

Paratypes.—The four workers sent with the holotype show variation of visible degree only in slight differences of size and proportion. Total length 1.88–2.03 mm., head length 0.51–0.55 mm., alitrunk length 0.46–0.53 mm., cephalic index 96–98, mandibulocephalic index 19–20.

The female caste is unknown. Males taken at Tucumán more recently, but not associated with workers or females, are possibly of this species. When association is certified, these specimens should be described—but certainly not before.

FIG. 1

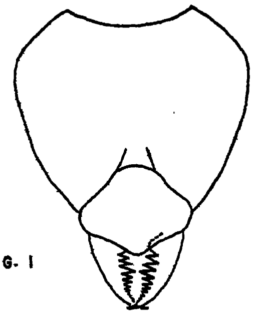

FIG. 2

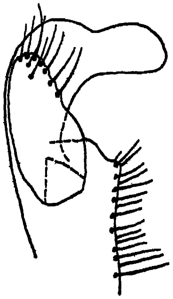

Fig. 1. *Glamyromyrmex* (*Chelystruma*) *lilloana* new subgenus and species, head of worker, facial view. (Tucumán, Argentina.)

Fig. 2. *Glamyromyrmex* s. str. *beebei* Wheeler, volsella of male genitalia. (Pará, Brazil.)

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PRELIMINARY DESCRIPTIONS OF SEVEN NEW SPECIES OF THE DACETINE ANT GENUS SMITHISTRUMA Brown

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(Plate III)

I have recently completed a manuscript in which the genus *Smithistruma* of the world is revised in its entirety.[1] New species from all parts of the range are described in this manuscript. Unfortunately, it appears that final publication of the full revision will not take place for some time. Meanwhile, Dr. M. R. Smith is awaiting the galley proof on a catalog of the North American ants, and he has requested that I publish several of these names so that they may be included in the catalog. Also, several European specialists have indicated to me that they have new species from the Ethiopian region for which description is planned. At least one of the species, held by Sr. Mario Consani, is, I believe, scarcely differentiable from *Sm. truncatidens,* a new species described below. Sr. Consani has indicated that he will wait until my description of *truncatidens* appears before describing his closely related form. Therefore, I am setting forth abbreviated descriptions of five new species from the United States and two from the Ethiopian region. In addition, I have given a key to the known Ethiopian species of the genus in order to facilitate identification in that formerly confused fauna.

North American Species

Smithistruma (Smithistruma) filirrhina new species

HOLOTYPE WORKER.—Total length (TL) 2.17 mm., head length (HL) 0.56 mm., length of alitrunk (WL) 0.55 mm., cephalic index (CI) 69, mandibulo-cephalic index (MI) 22.[2] Very similar in form of head and in other ways to *Sm. bimarginata* L. and R. Wesson. The clypeus, as in the latter species, is strongly bisemarginate along the free border. Disc of the clypeus concave or shallowly transversely sulcate, shining, with a few minute piligerous tubercles mostly restricted to a narrow belt just inside of and following the cultrate dorsal margin of the free clypeal border. The groove between upper and lower margins is filled with a hard black substance, quite conspicuous, which may represent foreign material. Clypeal hairs mostly concentrated along free border, very fine and filiform, their apices appearing not to be enlarged at magnifications of 85X. More of the hairs are concentrated toward the anterior part of the clypeal disc than elsewhere, and most are curved more or less away from the midline. On the posterior half of the disc, inside each lateral corner, there arises a very long, weak and crooked, but perpendicularly erect flagelliform hair. Of this long pair, that on the left side is as long or nearly as long as the clypeal disc itself, while the one on the right side is somewhat shorter and has apparently been broken off just above the middle of its length. On each side, in the general region of the two very long hairs, there are two or three shorter, but still flagelliform, erect hairs with gently posterolaterally curved apices. Pilosity of upper dorsum of head much as in *Sm. laevinasis*, finely filiform and subreclinately arched toward the midline. A pair of long, fine flagellate hairs on the occiput and a single flagellate hair on each lateral occipital border. Other body hairs very fine, much as in other *Smithistruma*.

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[1] Thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Biology, Harvard University.

[2] All measurements and indices are followed by symbols in parentheses; these symbols indicate that the values given are strictly comparable to those I have set forth in previous papers on the tribe Dacetini. See Part I of the Revision in Mushi, XX, p. 2 (1949). A fuller treatment of measurements and proportions will be given in the section of the Revision to be published as soon as possible.

Mandibles not dissected, but dentition rather distinct even at full closure; basal lamella acute and tooth-like, mostly visible in front of clypeal border; diastema following large and distinct, at least as long as the length of the basal lamella. Dentition and structure much as in *bimarginata* as far as can be determined by direct comparison.

Color medium ferrugineous, basal gastric tergite feebly infuscated.

Holotype, a unique, taken in a Berlese funnel sample of pine-holly leaf mould at Williamston, North Carolina (D. L. Wray) on Dec. 17, 1946. To be deposited in the United States National Museum.

This species belongs to the *bimarginata* group. It may be distinguished from *bimarginata* by the much finer and otherwise different pilosity of the clypeus and verticocciput. From the members of the *clypeata* group, some of which show slight clypeal bisemargination, it may be distinguished by the very sparse and differently formed clypeal pilosity and by the large and prominent mandibular diastemata.

Smithistruma (Smithistruma) wrayi new species (Plate III, fig. 5.)

Holotype Worker.—Total length (TL) 2.02 mm., head length (HL) 0.53 mm., length of alitrunk (WL) 0.50 mm., cephalic index (CI) 70, mandibulo-cephalic index 17. Resembling and very close to *Sm. talpa* (Weber), of which *Strumigenys* (*Cephaloxys*) *venatrix* L. and R. Wesson is a synonym. The chief difference is one of clypeal pilosity, and this is very striking even at first glance. Sides of free clypeal border each with four prominent well-spaced, inverted spoon-shaped hairs, broader than the corresponding hairs of *talpa* and curved strongly away from the midline, the apices of some directed more or less posteriorly. Four reduced hairs at the center of the anterior portion of the free border also are directed somewhat laterally. Disc of clypeus granulose-punctulate, opaque, with inconspicuous but rather abundant and evenly distributed small, posteriorly inclined finely subspatulate hairs. Gastric costulae extending more than ⅓ the length of the basal tergite, considerably longer and more distinct than in most *talpa* workers I have seen. Color medium ferrugineous, first gastric segment a bit darker and more brownish. In all other characters this species resembles *talpa* very closely.

Holotype, a unique, deposited in the Museum of Comparative Zoology at Harvard University; collected with the aid of a Berlese funnel from leaf mould at Fayetteville, North Carolina. This species is named for the collector, Dr. David L. Wray, who has added very substantially to the knowledge of the Nearctic ant fauna through his zealous efforts to make known the microgenton of North Carolina.

Smithistruma (Smithistruma) filitalpa new species (Plate III, fig. 4.)

Holotype Worker.—Total length (TL) 2.06 mm., head length (HL) 0.54 mm., length of alitrunk (WL) 0.52 mm., cephalic index (CI) 66, mandibulo-cephalic index (MI) 17. Similar to *talpa*, but perhaps a little more slender than is usual in the common species. Clypeus extremely slightly broader than long, opaque, differing from that of *talpa* in its pilosity, which is slightly longer, more abundant, and with the individual hairs clearly more slender, weaker, and not having their apices enlarged at magnifications of 60X–120X. The fringing hairs are curved weakly anteromedially; those on the surface of the disc are evenly distributed, weakly arched-subreclinate, nearly or quite as long as the fringing hairs. Hairs on the verticocciput stouter, more nearly clavate or spatulate and more erect than in *talpa*. Lateral borders of occipital lobes each with two long outstanding weak flagelliform hairs.

Pronotum in profile shallowly but distinctly concave, meeting the mesonotum through an obtusely rounded angle. Median pronotal carina very indistinct, but continued a bit more distinctly on the mesonotum. The feebly concave parts of the pronotum with sculpture more or less effaced, so that large areas of the pronotal dorsum appear smooth and shining, as is also the case with the petiolar node. Basal costulae of gaster shorter than in *talpa*, extending not quite ¼ the length of the basal tergite. Color light ferrugineous.

Holotype, a unique, in the collection of the United States National Museum, the label stating, "Pike Co., Arkansas, [collected by] W. F. Turner."

The two new forms *wrayi* and *filitalpa* appear to be divergent-pilosity variants of the *talpa* group. *Wrayi* parallels *Sm. reflexa* L. and R. Wesson of the *pulchella* group so far as clypeal pilosity is concerned, while *filitalpa* appears to parallel *pilinasis* of the *clypeata* group in the same way. The pilosity of *filitalpa,* however, is even finer than that of *pilinasis.* While both of these new species are known from single specimens, I believe they will be found more abundant when Berlese funnel collecting is extended to the more open, grassy areas where the *talpa* group species appear to flourish.

Smithistruma (Smithistruma) californica new species

HOLOTYPE FEMALE.—Total length (TL) 2.41, head length (HL) 0.64, cephalic index (CI) 67, mandibulo-cephalic index (MI) 17. Closely related to *Sm. rostrata* (Emery) and to the Japanese species *rostrataeformis* Brown and *incerta* Brown. Differs from *rostrata* in considerably smaller size and in the shorter, broader hairs of the free clypeal border, particularly those on the anterolateral "corners" of the clypeus. Humeral angles each with a distinctly flagelliform hair; gastric hairs flagelliform, erect, distinctly more numerous than are those of either worker or female of *rostrata.* Propodeal teeth short, compressed, subtended by convexly expanded infradental lamellae. Dorsum of petiole with sculpture more or less effaced, subopaque to weakly shining in varying lights. Mandibles shorter than those of *rostrata,* but appearing similarly toothed; no diastema evident, even in partially open mandible. Differs from the types of *incerta* (female and worker) and *rostrataeformis* in details of pilosity and in proportions of head, clypeus and mandibles. The anterior median clypeal emargination is present but very weak, not so well developed as in *incerta,* but perhaps a little stronger than in the majority of *rostrata* females. Color ferrugineous yellow; apex of gaster slightly darkened. Remnants of wings present.

Holotype and single paratype (see below) taken at Claremont, California (C. F. Baker). The data go no farther, as might be wished in the case of the only certain record for a member of the genus from west of the Great Plains in North America. Whether this locality is in the irrigated, intensively cultivated region around Claremont or in one of the canyons near the city may make the difference between an ant introduced from the Orient or one native to California. Dr. A. C. Cole claims to have taken another *Smithi-*

struma near the Oregon-California border, and Dr. M. R. Smith, who saw this specimen, thought it belonged to the *clypeata* group. This information has been transmitted to me in a series of letters, but the actual specimen appears to have been misplaced. We urgently need confirmation of this find through further collections.

The *paratype,* also a female with large parts of the wings remaining, unfortunately lacks a head. The two females were probably captured during or just after the nuptial flight. These two (holotype and paratype) specimens, now in the Museum of Comparative Zoology, are the basis for the record of *rostrata* from California. Wheeler made the original determination, and this record appeared in Smith's revision of 1931. Dr. W. S. Creighton has rightly called this record to question in his book on North American ants (1950).

Smithistruma (Smithistruma) bunki new species (Plate III, figs. 2, 3.)

HOLOTYPE WORKER.—Total length (TL) 2.24 mm., head length (HL) 0.58 mm., length of alitrunk (WL) 0.55, cephalic index (CI) 66, mandibulo-cephalic index (MI) 18. Head shape as in *pulchella* and *rostrata*; clypeus distinctly broader than long and more than half the breadth across the occipital lobes. Mandibles as in fig. 2, with 5 principal teeth in the apical series (only 4 in *creightoni*) and the diastema very small, shorter than the length of the basal lamella. The anterior clypeal border is transverse, with a slight suggestion of emargination in some views.

The pilosity very similar to that of *Sm. creightoni* (M. R. Smith), but the hairs less numerous, and those on the free clypeal margin larger, broader, and spaced farther apart than in *creightoni.* Each humeral angle with a stiff, outstanding simple hair, about twice as long as the other promesonotal hairs. Head without erect hairs. Alitrunk like that of *creightoni* in form, but the infradental lamellae a little broader, not strongly concave, slightly convexly expanded below. Color light ferrugineous.

Holotype in United States National Museum; selected from a small colony-series taken in a pine woods near Landon, Mississippi (A. C. Cole, Jr.). The paratypes represent the type locality and specimens from four other colonies taken at three additional localities: Savannah, Georgia, two colonies (H. T. Vanderford). Bayou Liberty, Slidell, Louisiana (W. L. Brown). Welaka, Putnam Co., Florida (A. Van Pelt). Paratypes will be deposited in the collections of the United States National Museum, the Museum of Comparative Zoology, the Academy of Natural Sciences of Philadelphia, Dr. A. C. Cole, Jr., and those of other individuals and institutions. The female will be described in the full revision.

This species is placed in the *rostrata* group in spite of the weak diastemata present in the dentition of the mandibles. Apparently it represents a pilosity form paralleling *creightoni;* the latter belongs to the *talpa* group. The similarity between this species and *creightoni* is very strong, and it is suggested that determinations be checked by the mounting in balsam of at least one mandible from a worker of any series suspected of belonging to either species. The paratypes of *bunki* show considerable variation in the humeral hairs, which may either be absent or somewhat flagelliform. Named for the late Bunk Johnson, of New Iberia, Louisiana.

Key to the Workers of the Known Ethiopian Species of Smithistruma

1. Clypeus with a very deep anterior semicircular excision; mandibles very small, partly recessed in the excision (MI 7); clypeal hairs very broadly suborbicular and conspicuous; total length under 2.10 mm. (Belgian Congo) .... *cavinasis* n. sp.
   Clypeus with a transverse or broadly and shallowly emarginate anterior border; mandibles larger, more projecting (MI over 10); clypeal hairs not broady suborbicular; total length over 2.10 mm. 2
2. Head very long and narrow (cephalic index under 65), depressed. (S. Africa) .... *emarginata* (Mayr)
   Head broader (cephalic index over 65) 3
3. Anterior clypeal border gently emarginate; prominent erect hairs on alitrunk at most two pairs; MI under 20; mandibular dentition as in fig. 1 (E. Africa) .... *truncatidens* n. sp.
   Anterior clypeal border straight; more numerous prominent erect hairs on alitrunk; MI over 20; mandibular dentition insufficiently known (from original description) (S. Africa) .... *transversa* (Santschi)

Smithistruma (Smithistruma) cavinasis new species

HOLOTYPE WORKER.—Total length (TL) 2.01 mm., head length (HL) 0.55 mm., length of altitrunk (WL) 0.50 mm., cephalic index (CI) 63, mandibulo-cephalic index (MI) 7. Head shape of the *rostrata* group, but occipital border only very shallowly concave, anterior clypeal border deeply and semicircularly excised; the clypeal excision considerably greater than that of any other *Smithistruma* species known to me for the entire world fauna. Antennal scape sharply bent at about its basal quarter; apical segment of funiculus about 1½ times as long as the four basal funicular segments taken together. Mandibles very short, depressed, seen from above and fully closed, with a large part of the length recessed into the clypeal excision.

Dentition apparently consisting of an uninterrupted series of slender acute teeth; no diastema seen; shape of basal lamella not determined. Alitrunk compact; dorsal outline in profile weakly convex; pronotum without humeral angles. Propodeal teeth short, triangular, acute; infradental lamellae very slight, diminishing ventrally. Petiole with a slender peduncle and a small, dorsally rounded, bicarinulate node. Postpetiole broad and very convex, about twice as broad as the petiolar node.

Head, scapes, legs and petiole densely punctulate and opaque. Alitrunk feebly reticulate, subopaque; promesonotal dorsum finely and irregularly longitudinally striate or rugulose. Basal costulae of gaster delicate but distinct, well spaced, extending about ⅓ the length of basal tergite. Head with comparatively few, but large and quite conspicuous, whitish, thickened and suborbicularly broadened squamose hairs, the blades set very close to the integumental surface, but not strictly appressed. The hairs are more crowded, flatter and slightly smaller on the clypeal disc; six rather prominent ones bordering the excision. More elongate spatulate hairs on lateral clypeal borders and on anterior scape borders. No erect hairs on head or alitrunk of this specimen, but the first gastric tergite near its basal edge with a single pair of short, mesially inclined clavate hairs; apex of gaster with a few short, fine, erect clavate hairs Color sordid yellowish-ferrugineous.

Holotype, a unique, returned to Dr. N. A. Weber for eventual deposition in the collections of the American Museum of Natural History. Collected during February, 1948, in the Ituri Forest between Beni and Irumu, Belgian Congo (N. A. Weber, cat. no. 2129).

This very aberrant *Smithistruma* is distinct by so many strong, definite characters from all the other known species that little confusion should be expected with regard to it.

Smithistruma (Smithistruma) truncatidens new species (Plate III, fig. 1.)

Holotype Worker.—Total length (TL) 2.36 mm., head length (HL) 0.62 mm., length of alitrunk (WL) 0.64 mm., cephalic index (CI) 73, mandibulo-cephalic index (MI) 14. Related to *Sm. emarginata*, but differing in its more robust body build and especially in its broader, more "normal" head. Superficially, it resembles somewhat the larger members of the Neotropical *schulzi* group. Occipital lobes broadly expanded laterally; preocular laminae approximately parallel and feebly convex. Clypeus subpentagonal, with the anterior border broadly and very shallowly emarginate and anterolateral angles distinct but rounded. Clypeal disc slightly broader than long and about half as broad as the distance across the occipital lobes. Antennal scape bent at about a 40° angle near base, incrassate. Funicular apical segment slightly longer than the four basal segments taken together. Mandibles in place and closed resembling those of *rostrata*, without a distinct diastema (see fig. 1). The distinctive basal lamella is the basis for the name "*truncatidens*".

Alitrunk slightly depressed; promesonotum weakly convex, posterior mesonotum depressed and nearly continuous with the propodeal dorsum. Petiolar node broader than long and shorter than its peduncle, anterior declivity steep and not, or very indistinctly, bicarinate; spongiform appendages moderately well developed. Postpetiole transversely oval, about 1.3 times as broad as long and about 1.4 times as broad as the petiolar node, its dorsal surface convex and very obscurely and indefinitely longitudinally striate, but at lower magnifications appearing smooth and shining; spongiform appendages fairly well developed posterolaterally and ventrally, but the posterodorsal isthmus poorly developed and interrupted in the middle. Gaster weakly depressed dorsally, but not impressed anteromedially; median basal costulae partially effaced, but those on each side parallel and longitudinal, extending about half the length of the basal tergite. Remainder of gastric dorsum smooth or nearly so; a few roughened patches may represent a hardened secretion. Sculpture of body as usual for the genus, except that the pronotum has obscure longitudinal striation superimposed on the dense punctulation; posterior sides of alitrunk partially smooth and shining.

Head dorsally with rather abundant but inconspicuous, subreclinate to subappressed, short spoon-shaped hairs, a few on the posterior and lateral occipital regions slightly longer, more nearly clavate and obliquely suberect. Hairs on clypeal disc extremely small and inconspicuous; hairs on free clypeal border much larger, spoon-shaped and curved toward the middle, about 12 on each side of the midline, forming a fringe much like that of *rostrata*, except that the hairs on each side of the anterior border, on the anterolateral "angles," while longer than the others, are not so much so as in *rostrata*; in addition, the fringing hairs are all broader than the corresponding ones of *rostrata*. Alitrunk with a very few small, extremely inconspicuous narrow reclinate hairs. No prominent humeral hairs in holotype (or in paratypes); these may have been rubbed off if once present. Mesonotum with a pair of prominent erect hairs, appearing feebly clavate. Petiolar node with a pair of long clavate hairs; postpetiole with about 8 and gaster with 18–24 stiffly erect or suberect clavate hairs.

Color dull yellowish-ferrugineous.

Holotype one of four workers taken by K. Bock at Lupembe, Tanganyika Territory. The paratypes (3) vary only very slightly in size and proportions; the largest worker has the head slightly infuscated posteriorly. Holotype in the collection of Sr. Mario Consani, Florence, Italy, together with two paratypes. One paratype in the collection of the Museum of Comparative Zoology.

Another specimen, which I refer to *truncatidens*, was taken by S. Patrizi at Elmenteita, Kenya. The head length (HL) is 0.69 mm. and the cephalic index (CI) 73. The body is larger overall than in the *truncatidens* types, the substriation is a little stronger on pronotum and postpetiole, and the basal gastric costulae are stronger; also, there appears to be a sort of superficial shagreening of the gastric surface, but this may be due largely to the presence of a hardened secretion or other matter. There is a small subspatulate hair on each humeral angle, and the color is slightly but distinctly darker (medium ferrugineous) than in the Lupembe specimens. The mandibles are identical from external view, and were not dissected. Sr. Consani regards this specimen as possibly representing a different species or subspecies, but I am unable to agree with this on the basis of the present evidence and in view of the fact that the closely related species *emarginata* is highly variable in similar characters. Earlier entomologists would have relegated this form to varietal status, but modern taxonomy has no place for the naming of any infraspecific variant that cannot be certainly placed as a geographical race or subspecies.

Both new African species, plus also *emarginata* and *transversa*, are placed for convenience in the "*emarginata* group," which may be little more than the African branch of the *rostrata* group.

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EXPLANATION OF FIGURES

PLATE III

Fig. 1.—*Smithistruma* (*Smithistruma*) *truncatidens* new species, paratype worker, left mandible, dorsal view. Lupembe, Tanganyika.

Fig. 2.—*Smithistruma* (*Smithistruma*) *bunki* new species, paratype worker, right mandible, ventral view. Landon, Mississippi.

Fig. 3.—*Smithistruma* (*Smithistruma*) *bunki* new species, paratype worker, cypeal outline. Slidell, Louisiana.

Fig. 4.—*Smithistruma* (*Smithistruma*) *filitalpa* new species, holotype worker, clypeal outline. Pike Co., Arkansas.

Fig. 5.—*Smithistruma* (*Smithistruma*) *wrayi* new species, holotype worker, clypeal outline. Fayetteville, North Carolina.

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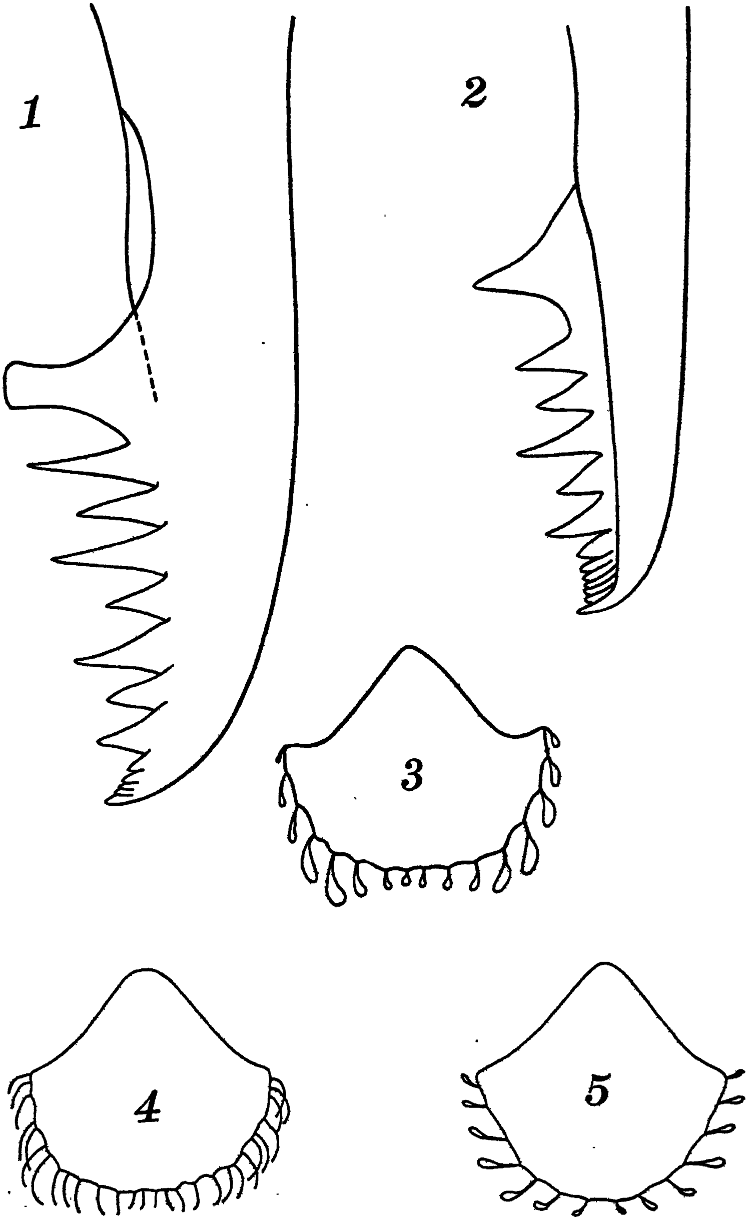

BROWN—NEW SPECIES OF DACETINES

PAUSSID BEETLES

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(Text-figures, maps, diagram)

This paper began with the discovery (or rediscovery, for a few specialists had known it before) that paussids (Figs. 1-6) are just Carabidae with striking adaptations for life with ants.[1] The discovery started me on a survey of paussid comparative anatomy, phylogeny, classification, and distribution. What I now have to say about paussids is still only an introduction to them. They pose a variety of fascinating, unsolved problems. I hope in a few years to return to them and to clear up at least some of the outstanding taxonomic problems. In the mean time I need much more material, dry or in alcohol, from all parts of the world where paussids occur.

The paussids are a primarily and perhaps wholly myrmecophilous group. The striking features of their evolution are all adaptations to life with ants. All their larvae may inhabit ants' nests and most adults do so too. Even adult *Protopaussus* has trichomes which contradict the old idea that it is free-living. However, adults of the Australian genus *Arthropterus* may be exceptions. They rarely occur with ants (Sloane 1933, 396-7); they lack trichomes (as do most other Cerapterina); and their mouths do not look like those of myrmecophiles (see p. 65). I suspect that *Arthropterus* and perhaps a few other paussids are myrmecophilous only as larvae, and that adults enter ants' nests only to lay eggs.

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[1] My interest in paussids is a by-product of work on Philippine and other Carabidae which has been aided by grant of a fellowship by the John Simon Guggenheim Memorial Foundation. The present paper is the first published result of the grant.

The habits of paussids are not well known. Some may occur only with single species of ants; others, with more than one species or even more than one genus. Some genera and higher groups of paussids occur only with particular ant genera; others, with diverse ant genera (Jeannel 1946, pp. 60, 61, 75; Reichensperger 1948, 14-15). The hosts of many undoubtedly myrmecophilous paussids, described from specimens with incomplete data or taken at light or in floods, are unknown. A supposed case of a paussid associated with termites rather than ants (Jeannel 1946, 60) needs confirmation. I have only one important new host-record: of a ♀ *Homopterus steinbachi* taken at Muzo, Dept. Boyacá, Colombia, by Dr. J. Bequaert, with *Dolichoderus* (*Monacis*) *bispinosus* Ol. (det. W. M. Wheeler). This seems to be the first host-record for any American paussid. Concerning the role of paussids in ants' nests, Wheeler many years ago (1910, 402-4) reviewed the little that was known and said, ". . . the behavior of very few has been carefully observed, and the accounts are so different as to indicate a wide range of myrmecophilous habits . . .". We know a few more details to-day (Reichensperger 1948, pp. 6ff; etc.) but can make no better generalization. It is likely that the evolution of myrmecophilous habits in the paussids has been complex, with much parallelism and occasional regression. This is strongly suggested by the parallelism and regression of trichome-systems and of other adaptive structures that have occurred in various paussids.

That paussids are essentially similar to Carabidae was shown more than a hundred years ago (Burmeister 1841) but was long disputed. Wasmann (various papers to 1929) thought that paussids were derived from Carabidae but that they were polyphyletic, that three or four different stocks of them had come from carabids as diverse as Ozaenini, Lebiini, and Brachynini. Kolbe (1927, 1930, etc.) denied this and was, I think, the first to insist that all paussids have ozaenine relationships. He was right. In all fundamental characters—general organization, mouth-parts, ventral structure, wing-venation, male copulatory organs, and such significant characters as their degenerate larvae retain (van Emden 1936; 1942, pp. 3 & 25)—paussids are Carabidae, and they are all derived from the primitive carabid tribe Ozaenini.

In order to understand the evolution of the paussids and their relationship to the Ozaenini it is necessary to make a careful survey of both groups. The collection of paussids in the Museum of Comparative Zoölogy is barely adequate for this. Our old material, received from Dohrn, Wheeler, and others, has been supplemented by selected genera and species received by exchange from the British Museum, and by smaller but very useful lots received by gift or exchange from Prof. A. Reichensperger, Prof. R. Jeannel, Prof. S. W. Frost, and Mr. C. J. Louwerens. To this has been added for study small lots borrowed from the United States National Museum, the American Museum (New York), the Academy of Natural Sciences of Philadelphia, the California Academy of Sciences, Cornell University, and Prof. Orlando Park. I am especially indebted to Prof. Reichensperger for identification, gift, or loan of several critical species and for notes on others, and to Mr. John Balfour-Browne of the British Museum for finding time to make an exchange when other duties were unusually heavy. I still have seen only about 100 out of perhaps 460 known, good species of paussids, but the ones I have seen include most recognized genera and many genotypes. Our collection of Ozaenini is relatively good, thanks to my own efforts and to Mr. M. Bänninger, who has identified many species for us and sent us others in the course of exchange. Of the 14 genera recognized by Bänninger in his useful revision of the Ozaenini (1927) we lack only *Anentmetus*, and we lack a male of only one other genus, *Itamus*. These lacks are probably not important for present purposes.

For convenience I have set up "standard series" of both Ozaenini and paussids (Table 1). Unless otherwise stated, these are the species actually examined in each case below. The names of these species will be used without authorities in the following pages.

TABLE 1. *Standard Series of Ozaenini*

Mystropomus subcostatus Chd.
Pseudozaena o. orientalis (Klug)
Itamus castaneus S.-G.
Sphaerostylus luteus (Hope) and/or *goryi* (Cast.)
Ozaena (near) *lemoulti* Bänn.
Platycerozaena panamensis Bänn.
Goniotropis seriatoporus (Chd.) and/or *elongatus* (Chd.)

TABLE 1. (*continued*)

Pachyteles arechavaletae Chd. and/or *striola* (Perty)
Tropopsis cyanipennis (Chd.)
Microzaena madecassa Fairm.
Eustra plagiata matanga Andr.
Dhanya bioculata Andr.
Physea setosa Chd.

Standard Series of Paussids

"PRIMITIVE PAUSSIDS"
  (Tribe Protopaussini)
    Protopaussus bakeri Heller (♂ only)
  (Tribe Paussini)
    (Subtribe Cerapterina)
      Carabidomemnus pallidus (Raffr.) (♂ ♀) (genotype)
      Arthropterus spp. (♂ ♀)
      Cerapterus latipes Swed. (♂ only) (genotype), and/or *lafertei* Westw. (♂ only), and/or *sp.* fr. E. Africa (♀)
      Pleuropterus westermanni Westw. (♂ ♀) (genotype), and/or *alternans* Westw. (♂ only)
      Homopterus hondurensis Darl. (♂ only) and *steinbachi* Kolbe (♀ only), and *Arthropteropsis praemonens* Kolbe (♂ only)
    (Subtribe Pentaplatarthrina)
      Pentaplatarthrus natalensis Westw. (♂ ♀) and/or *gestroi* Kolbe (♂ ♀)
"DERIVATIVE PAUSSIDS"
    (Subtribe Platyrhopalina)
      Platyrhopalus denticornis (Don.) (♂ only) (genotype), *angustus* Westw. (♂ ♀), and/or *irregularis* Rits. (♂ only)
      Euplatyrhopalus aplustrifer (Westw.) (♀ only) (genotype)
      Lebioderus goryi Westw. (♂ ♀) (genotype) and/or *bakeri* Heller (♂ only)
      Platyrhopalopsis mellyi (Westw.) (♂ ♀) (genotype)
    (Subtribe Ceratoderina)
      Merismoderus bensoni Westw. (♀ only) (genotype)
      Ceratoderus bifasciatus (Kollar) (♂ ♀) (genotype) and/or *oberthuri* Gestro (♂ ♀)
      Paussomorphus chevrolati (Westw.) (♂ ♀) (genotype)
    (Subtribe Paussina I)
     (African forms)
      Edaphopaussus spinicoxis (Westw.) (♂ only) and related *sp.* (♀)
      Edaphopaussus armatus (Westw.) (♂ ♀)
      Edaphopaussus procerus (Gerst.) (♂ ♀)
      Edaphopaussus manicanus (Pér.) (♂ only)

TABLE 1. (*continued*)

- *Bathypaussus aldrovandii* (Gestro) (♂ only) (genotype) and/or *cultratus* (Westw.) (♂ ♀)
- (Southern Palearctic form)
  - *Edaphopaussus favieri* (Fairm.) (♂ only)
- (Indian form)
  - *Edaphopaussus hearseanus* (Westw.) (♂ only)
- (Subtribe Paussina II)
  - (African stocks)
    - *Paussus microcephalus* L. (♂ only) (genotype)
    - *Paussus cucullatus* Westw. (♂ ♀)
    - *Paussus laetus* Gerst. (♂ ♀)
    - *Paussus klugi* Westw. (♂ ♀)
    - *Paussus curtisi* Westw. (♂ ♀)
    - *Paussus donisthorpei* Wasm. (♂ only)
    - *Falcopaussus granulatus* (Westw.) (♂ ♀) (genotype)
    - *Hylotorus hottentottus* Westw. (♂ ♀)
  - (Madagascan stock(s))
    - *Paussus scyphus decorsei* (Jean.) (♂ only) and *glabripennis* (Jean.) (♀ only)
    - *Paussus armicollis* Fairm. (♂ ♀)
    - *Enneapaussus howa* (Dohrn) (♂ ♀) (genotype)
    - *Anapaussus dama* (Dohrn) (♀ only) (genotype) and/or *elaphus* (Dohrn) (♂ ♀)
  - (Southern Palearctic species)
    - *Paussus turcicus* Friv. (♂ ♀)
  - (Oriental stock(s))
    - *Paussus wroughtoni* Wasm. (♂ ♀) and/or *boysi* Westw. (♂ ♀)
    - *Paussus seriesetosus* Wasm. (♂ ♀)
    - *Paussus jerdani* Westw. (♂ only)
    - *Paussus kannegieteri* Wasm. (♂ ♀)
    - *Paussus andreae* Rits. (♂ ♀)

COMPARATIVE ANATOMY

All the characters that have been used to define the "family" Paussidae and to separate it from the Carabidae fail or are reduced in value when the paussids are carefully compared with the carabid tribe Ozaenini.

The myrmecophilous habit is not definitive. All paussids may be myrmecophilous in some stage, if not always as adults, but so is at least one genus of the Ozaenini, *Physea,* of which both larvae and adults live with tropical American ants of the genus *Atta* (Van Emden 1936, and authors cited by him).

Paussid larvae probably show the effects of myrmecophilous life even more than do the adults, but the larvae of only four species are known (Reichensperger 1948, 8), and only a few ozaenine larvae are known for comparison. Fortunately one of them is *Physea,* the larva of which is intermediate between the usual carabid type and the degenerate paussid type (Van Emden, *op. cit.*).

Adult paussids possess some external characters that seem to be non-adaptive or at least non-myrmecophilous (elytral fold and loss of margin, wing venation), others of unknown adaptive significance (loss of setae, modification of coxae and ventral segments, stridulatory organs, exposed pygidium), and still others that are obviously myrmecophilous adaptations (glandular structures, modification of antennae, loss of comb organ, modification of mouth-parts and legs). I shall discuss these characters in the order given, and shall then consider secondary-sexual and genitalic ones.

Elytra.—The paussid elytron (Fig. 21) shows two significant characters. First is a subapical fold of the outer edge of the elytron. The fold is present in all paussids and also in all Ozaenini, but in no other Carabidae. This alone is almost enough to prove the ozaenine origin of all paussids. Second is loss of the elytral margin. In the Ozaenini the elytron (Figs. 19-20) has a raised external margin which divides the main part of the elytron from the inflexed epipleura. In the paussids the raised margin is lacking. This character, which seems not to have been used before, is the most convenient one I have found to separate the paussids from the Ozaenini, but it is not very fundamental. The raised margin is present in most Carabidae, but a brief survey shows it to be absent not only in the paussids but in several other, unrelated carabid groups: for example, in some tiger beetles (Cicindelinae), especially in the more cylindrical ones (*Pogonostoma, Tricondyla,* etc.); in *Drypta* and *Desera;* and in *Selina.* In these cases the elytral margin has disappeared in Carabidae which are very convex or cylindrical. Its absence in the paussids may mean simply that the latter's ozaenine ancestor was cylindrical, and it may be significant that the elytral margin, though present, is weak and partly obliterated in subcylindrical *Ozaena*

(Fig. 20). The loss of the elytral margin by the paussids is probably not a result of the beetles' association with ants, for the myrmecophilous ozaenine *Physea* has a very well developed elytral margin (Fig. 19).

Wings.—The inner or flying wings of paussids are of the usual carabid type, with a minor but noteworthy modification of the median cell. This cell is variable in the family Carabidae, but in my standard series of the tribe Ozaenini it is fairly uniform, at least in fully developed and veined wings (Fig. 7). The median cell of the Ozaenini is quadrangular, usually subparallel, less often (*Sphaerostylus, Microzaena,* and especially *Dhanya*) more or less widened in front. However, two ozaenine genera are exceptions which, without destroying the truth of the general statement just made, illustrate a common limitation of wing-characters of beetles. In *Mystropomus* the wings are vestigial in all three known species and the venation is lost. And in small *Eustra matanga* the wing is fully developed in proportion to the size of the insect but the venation is reduced and the median cell obliterated. Such reduction of venation occurs in small Carabidae as a direct result of small size (Darlington 1933, 113) and is not of phylogenetic significance.

In the paussids, *Protopaussus* (Fig. 8) has the median cell of the ozaenine type, but all other paussids of the standard series have the cell triangular, narrowed in front, with the anterior point of the triangle touching the Media or (usually) connected to it by a single, stem-like vein. Within the subtribe Cerapterina the triangle and stem are surprisingly variable: in *Homopterus* the triangle is large and the stem almost absent (*H. steinbachi,* Fig. 12) or short (*H. hondurensis*); in *Carabidomemnus pallidus* (Fig. 13), *Cerapterus stali* Westw., and also *Cerapterites primaevus* Wasm. of the Baltic amber (Wasmann 1929, Pl. 3, his Fig. 24) the stem is short; in *Arthropterus piceus* Westw. and *Pleuropterus hastatus* Westw. the triangular cell is proportionately slightly smaller and the stem slightly longer; and in another species of *Arthropterus* (perhaps *planicornis* Sl., Fig. 14) the triangle is still smaller and the stem as long as in some derivative paussids. In *Pentaplatarthrus* (Fig. 15) triangle and stem are of intermediate proportions. In the derivative paussids of my standard series the triangle is always small and the stem long (Figs. 16-18), although there is some variation.

It will be seen that the paussids show the whole transition of the median cell from the relatively large, quadrangular, ozaenine form still present in *Protopaussus* to the small, oval-triangular, long-stemmed form of the derivative subtribes. The greater part of the transition occurs in the subtribe Cerapterina.

Comparison of the wings of different paussids helps to prove the homogeneity of the group and the underlying simplicity of its evolution. If earlier authors had examined the wings (none has, except to figure single species), they might have avoided a good deal of pointless guessing about polyphyletic origins.

It should be added that, although the main pattern is fairly constant, the details of venation of the paussid wing are more or less unstable. In the material before me are cases both of duplication and of elimination of certain veins, and in at least some of the cases the variation seems to be merely individual.

Until recently it has been supposed that the inner wings of paussids are always well developed. This is indeed the rule, but there are exceptions to it. Sloane (1933, 397) states that different species of Australian *Arthropterus* have the wings (a) well developed in both sexes; (b) well developed in the ♂, vestigial in the ♀; or (c) vestigial in both sexes. The 30 specimens of *Arthropterus* in the Museum of Comparative Zoölogy confirm Sloane's findings in part. Some species (*e. g. piceus* Westw.) do have well-developed, others (*e. g. brevis* Westw.), vestigial wings. As to dimorphically winged species, they are common among Carabidae, but the dimorphism seems usually to be simply Mendelian, not sexual (Darlington 1936; Lindroth 1946). Sloane's finding of sexual dimorphism in *Arthropterus* needs confirmation, and is not confirmed by the limited material in the M. C. Z. We have only one apparently dimorphic species of *Arthropterus*, identified as *angulatus* Macl. Our two specimens of this are labeled only "Australia", but both were received from Dohrn and were very likely obtained by him from one source. The two agree very well indeed except that one has fully developed and the other vestigial wings (Fig. 9). The genitalia show that both are males.

There may be a correlation between loss of wings by some *Arthropterus* and loss of myrmecophilous habits of adults (*cf.* Darlington 1936, 163).

I have found wing-atrophy in two other paussids of different subtribes. One is the ceratoderine *Paussomorphus chevrolati,* a definitely myrmecophilous species of Abyssinia. Of nine specimens examined, all have reduced wings. Six are males with wing-remnants about ¾ as long as the elytra; three, females with remnants about ¼ as long as the elytra (Fig. 10). The other is *Paussus seriesetosus,* a myrmecophilous Indian species. The single male examined has fully developed wings; the single female, somewhat reduced ones (Fig. 11). These findings strongly suggest that the wing-dimorphism of some paussids may be sexual, as Sloane thought.

Fixed setae.—"Fixed setae", presumably tactile in function, occur on definite parts of the body in most Carabidae (Bänninger 1927, 180-1), but tend to be reduced in the Ozaenini and are completely lost in some *Ozaena* and *Platycerozaena* (Bänniger, *l. c.*). They are absent also in all the paussids of my standard series.

Coxae.—The front coxae of most Carabidae including the Ozaenini (Fig. 22) are more or less oval, project only a little from their sockets, and are separated by a flat prosternal process. In *Protopaussus* (Fig. 23) the front coxae and prosternal process are still of the normal carabid form. In the cerapterine *Carabidomemnus* (including *Carabidodoxus*) the front coxae are a little more prominent and the prosternal process which separates them is reduced to a thin septum which is visible in some species (Fig. 24) but apparently not in others (Wasmann 1928, 269). In all other paussids of my standard series, including the other genera of Cerapterina, the front coxae are very prominent and contiguous or nearly so (Figs. 25, 26). The nearest thing to an exception is *Hylotorus* (Fig. 27), in which, in the course of evolution of a nearly cylindrical body, the front coxae have been reshortened, although they are still almost contiguous.

The middle coxae are variable, sometimes contiguous and sometimes separated, in different Ozaenini and in different paussids.

The hind coxae are slightly separated in most Ozaenini (Fig. 28), contiguous in the paussids (Figs. 30, 31), but the width of separation varies in different Ozaenini, and the coxae are almost contiguous in *Physea* (Fig. 29); and on the other hand the width of contact varies in the paussids. Actually, the Ozaenini are exceptional in this character. The hind coxae are contiguous in most Carabidae (Horn 1881, 101-2).

Ventral segments.—The first three ventral segments of the abdomen (Figs. 28 & 31) are more thoroughly fused in the paussids than in the Ozaenini or any other Carabidae, and the sutures between the segments are more or less obliterated. This character helps to define the paussids as a group, but it is not deeply significant. The segments in question are rigidly connected in all Carabidae, and the sutures between them, especially that between segments 2 and 3, are partly obliterated in the Ozaenini. No additional segments are involved in the fusion in the paussids, and traces of the sutures are still visible even in the derivative subtribes. The first segment is divided as in other Carabidae, and the metasternum has an ante-coxal piece. In fact the ventral structure of the paussids exactly follows the basic carabid pattern.

Stridulatory organ.—Ventral stridulatory organs (Fig. 31), not previously noticed by paussid students, occur in the subtribes Paussina I and II. They consist of two parts: (1) a "file" or slightly curved row of very short costae on the ventral surface of the abdomen on each side near the base, under the hind femora, and (2) a slightly raised, flat, finely striate area on the inner face of each hind femur near its base. These structures, varying only a little in form and position, occur in both sexes of all Paussina I and II, so far as my material goes. They are absent in all other paussids and all Ozaenini, and a brief survey reveals no other stridulatory apparatus in these groups, although some other Carabidae and many other beetles stridulate by means of diverse structures. I do not know what function stridulation may serve in the Paussina.

Pygidium.—The pygidium is covered by the elytra in most Ozaenini, more exposed and more heavily scleritinized in most paussids, but it varies in both groups. In one ozaenine genus, *Dhanya*, it is exposed: *Dhanya* is a genus of small, subcylindrical species which, in my experience (I have taken two species in the Philippines), are not myrmecophilous but live under the bark of logs in forest. And in such diverse paussids as *Protopaussus* and *Platyrhopalopsis* it is covered or nearly so.

Special glandular organs.—Trichomes and special glands are the most obvious adaptations of adult paussids to life with ants. Most (but not all) paussids have them. All Ozaenini and I think all other Carabidae lack them. I shall here consider only the presence or absence and the external structure of the glandular organs. The internal structure of some of them is described by Mou (1938).

The most important glandular systems of the paussids are those of the prothorax. They form four main patterns. (1) In *Protopaussus* as represented by *P. bakeri* (Fig. 32) the prothorax is deeply cleft at the sides anteriorly but without trichomes in the clefts, and is produced at the sides posteriorly, with trichomes on the processes. (2) In the subtribe Cerapterina prothoracic trichome-systems are lacking except in *Pleuropterus* (Fig. 33), which has (usually) a moderate trichome on and (always) a larger one under the basal margin of the prothorax on each side, as well as a large one on the front edge of each elytron opposite the main prothoracic trichome. (3) In *Pentaplatarthrus* (Fig. 34) the prothorax is intricately, more or less longitudinally cleft on each side anteriorly, with trichomes in the clefts. (4) In all the derivative paussids (Figs. 35-37) the prothorax is transversely cleft, or impressed, or at least sutured, and the cleft usually contains trichomes. These four patterns are so different and occur in paussids so different in other ways that I feel sure that they have originated independently, that four different paussid stocks have independently evolved prothoracic trichome-systems of different patterns.

A prothoracic trichome-system is primitively lacking among paussids only in the Cerapterina (excepting *Pleuropterus*), but has atrophied in at least four different stocks of derivative paussids. All the latter are apparently derived from an ancestor with a transverse, trichome-bearing prothoracic cleft. All species of the first derivative subtribe, the Platyrhopalina, lack the prothoracic cleft and trichomes, but all of them have a groove or suture across the pronotum (broken line in Fig. 3) in its place. That this is a vestige of an ancestral cleft can hardly be doubted; transition from a cleft to a groove or suture can be seen in each of the three following subtribes. In the subtribe Ceratoderina, the genera *Merismoderus* and *Paussomorphus* still have a cleft with trichomes, but in *Ceratoderus* the cleft is reduced to a groove without trichomes. In the subtribe Paussina I (*Edaphopaussus*) the cleft is usually comparatively simple (Fig. 35). In many of the species (*e. g. E. spinicoxis,* etc.) it contains trichomes, but in many others it does not. In *E. armatus,* etc. the cleft lacks trichomes and is reduced above to a more or less shallow groove, but an opening remains low down on each side, above the coxa. In some other species, probably representing several different stocks (*e. g. E. procerus,* etc. of Africa, *favieri* of the Mediterranean Region, and *hearseanus,* etc. of India), the cleft is reduced to a variable but relatively shallow impression with neither trichomes nor openings. And in *E. henningsi* (Reichensp.) and probably some other species the cleft has become simply a suture. In the subtribe Paussina II (*Paussus,* etc.) the prothoracic cleft (Figs. 36-37) is deeper and more stable, but even here it has atrophied in one group, *Hylotorus.* The few species of this genus show a complete transition of the cleft from an enormously developed, trichome-bearing form to a mere suture (Fig. 6) (*cf.* Reichensperger 1930).

The prothoracic trichome-patterns have not been much used in classification of higher groups of paussids. Nevertheless they divide all paussids into four groups which other characters show are natural ones:

1. *Protopaussus:* prothoracic trichome-pattern # 1 (above)
2. Cerapterina: no prothoracic trichome-system nor vestige, except that *Pleuropterus* has evolved pattern # 2
3. Pentaplatarthrina: prothoracic trichome-pattern # 3
4. Derivative paussids: transverse, trichome-bearing prothoracic cleft, or vestige of it.

Other glandular structures are few in the primitive paussids. In some *Pleuropterus* (*e.g. dohrni* Rits.) there are more or less dense patches of long, yellow hairs on the outer apical angles of the first few flagellar segments of the antennae; and the pygidium is fringed with shorter, more or less thickened hairs. In *Pentaplatarthrus* the pygidium is deeply notched above the declivity, with trichomes in the notch (Fig. 41). This structure has no counterpart in other paussids, unless perhaps in the unique pygidial slits of *Lebioderus* (Fig. 42).

In the derivative paussids, however, glandular structures are so diverse as to defy brief description. The antennae often bear trichomes, rarely on the scape (Fig. 82), commonly on the flagellum. On the latter the trichomes may be segmental (Figs. 53, 57, 59), basal (Figs. 62, 64, etc., 83), apical (Figs. 84-87), or on variously situated tubercles or processes (Figs. 56-58, 76, 80, 82, 91, 92, 93, 96). Some African Paussina I (*Edaphopaussus*) have a frontal horn with a presumably glandular opening at the tip (Fig. 40); and many Paussina II have paired, presumably glandular openings, without trichomes, on the front or vertex (Figs. 6, 38, 39). The openings may be level with the surface of the head or protected by, or raised on, costae or tubercles; and some Malayan *Paussus* have frontal horns like those of some *Edaphopaussus,* with the two openings sometimes merged into one (Fig. 39). The presence or absence, and the form of these openings, characterize some species-groups, but are not always stable characters. For example, paired frontal pores are present in *Paussus rufitarsis* Westw., usually absent in the related *P. boysi.* In the latter the pores are not even constant within the species. In one lot of three *boysi,* all from Chota Nagpur and all females, one has a pair of small, round frontal pores and the others lack them, as does a fourth female from Dehra Dun. Fringes and clumps of presumably secretory hairs and scattered single hairs occur on the head, prothorax, elytra, pygidial margin, and other parts of the body of many derivative paussids, especially of Paussina II, in great variety. The pygidial trichomes often form dense, marginal fringes of hairs. In some cases a fringe extends entirely around the posterior margin of the pygidium (Fig. 43); in others, it is more or less widely interrupted at middle (Fig. 44). The pygidial fringes of different Paussina are extremely variable in form, position, and length and thickness of hairs; and in a number of unrelated cases the pygidium lacks dense trichome-fringes. They are present in some Paussina I (*e. g.* in *Edaphopaussus spinicoxis*), but absent in others (*e. g.* in *E. procerus* and *favieri*); present in most African *Paussus,* but absent in a few (*e. g. curtisi* and *cylindricornis* Pér.) and absent also in *Falcopaussus* and *Hylotorus;*

present apparently in all Madagascan *Paussus,* but absent in *Enneapaussus* and *Anapaussus;* present in some Oriental *Paussus* (*seriesetosus, kannegieteri,* etc.), but absent in others (*boysi,* etc.). When the pygidium has marginal trichomes, it usually has also a strongly raised margin; when the trichomes are absent, the margin is often absent too. The presence or absence and the form of the pygidial trichome-fringes and the margin should be very useful in defining genera and species-groups within the Paussina. The trichomes have already been used in some cases by Jeannel (1946).

The occurrence of trichomes and other glandular structures mentioned in the preceding paragraph is so erratic as to suggest many separate minor lines of evolution, much parallelism, and many cases of secondary atrophy. In a few cases not only the prothoracic clefts but all other special secretory organs seem to have atrophied. Such cases occur in the Platyrhopalina (some *Platyrhopalus* and perhaps *Platyrhopalopsis*), Ceratoderina (*Ceratoderus*), and Paussina I (*Edaphopaussus procerus,* etc.), but apparently not in Paussina II. The few species of the latter group that have lost the prothoracic cleft (some *Hylotorus,* Fig. 6) have small antennal trichomes and large, paired, presumably glandular frontal pores.

Antennae.—The antennae of ozaenine Carabidae (Fig. 45) are always 11-segmented, and the segments are moniliform, short-cylindrical, or slightly flattened. In *Protopaussus* (Fig. 46) the antennae are still 11-segmented and moniliform, with no reduction of any segment. In the cerapterine *Megalopaussus* (Fig. 47) the antennae have 11 visible segments, but the second one is very small and deeply sunken into the apex of the scape. In the other Cerapterina (Figs. 48-51) the antennae appear 10-segmented, but the missing segment, the second, still exists as a small ring within the apex of the scape, and in this form it persists in all paussids. It is usually plainly visible in clean specimens and appears in most of my drawings of derivative paussid antennae (Figs. 53-103), and especially in some *Hylotorus* (Fig. 87).

Further modification of the paussid antennae has involved chiefly the flagellum, composed of original segments 3-11. In the Cerapterina the flagellar segments are always flattened, and except in *Megalopaussus* (Fig. 47) the segments are also moderately to very widely dilated. In two cerapterine genera the flagellum is still further modified: in *Homopterus* (*s. s.*) (Fig. 50) the segments overlap and are more or less fitted together on one side, and in *Pleuropterus* (Fig. 51) they are fitted together across their entire width. It is commonly said that the segments are fused in *Pleuropterus,* but in the seven species before me they are actually free and movable in relaxed specimens.

Further modification of the flagellum in different paussids has involved either reduction in number of segments, or fusion of segments, or both. In the Pentaplatarthrina (Fig. 52) the flagellum is reduced to 5 segments which, though fitted together, are still movable. In the derivative paussids the flagellar segments vary in number but are always soldered or fused together.

My drawings of derivative paussid antennae (Figs. 53-103) have been made with a camera lucida on a good stereoscopic microscope, with carefully adjusted lighting. They emphasize the outline and especially the segmentation of the flagellum. The segmentation is usually best seen when the flagellum, itself slightly illuminated, is observed against a strongly illuminated white background.

The phylogeny of the antennal flagellum of derivative paussids has been complex, with much parallelism. In each of the first three derivative subtribes (Platyrhopalina, Figs. 53-58; Ceratoderina, Figs. 59-61; and Paussina I, Figs. 62-73) the flagellum varies from a plainly 5-segmented to a more or less completely fused form. In each of these subtribes fusion of flagellar segments has evidently proceeded independently, and the process has probably been complex even within the subtribes. Note that in these subtribes the flagellum apparently never has more than 5 segments distinguishable.

In the Paussina II (Figs. 74-103) fusion has run ahead of reduction in number of flagellar segments. Here too there has been complex parallelism. It is not easy to work out the true phylogenetic lines. The flagellar segments are sometimes hard to count even when traces of them remain, and the significance of exact counts is doubtful. In some cases different numbers of segments can be distinguished on the two sides of one flagellum, and in the conchoid flagellum three different counts may sometimes be obtained. In *Paussus cucullatus* (Fig. 75) 5 or possibly 6 segments are distinguishable along the anterior margin, 7 along the lower posterior margin, and 8 along the upper posterior margin. The significant fact here is that more than five flagellar segments are distinguishable.

The full number of 9 segments is distinguishable in the fused flagellum in only one paussid that I have seen, *Enneapaussus howa* of Madagascar (Fig. 88), but probably occurs also in some African species that I have not seen, including *Paussus concinnus* Pér. (Fig. 74). Eight segments can be made out in *Paussus laetus* (Fig. 77), *klugi* (Fig. 76), *cucullatus* (Fig. 75), and probably other African and some Madagascan species (Fig. 89), and every smaller number of segments (7, 6, etc.) can be found in different Paussina II. Both *laetus* and *cucullatus* have apparent relatives in which the segmentation of the flagellum has been reduced or lost (*cf.* Figs. 77 & 78; 75, 89 & 90), and I suspect that segmentation has in fact been progressively obliterated in several different lines derived from *cucullatus*-like ancestors.

A "conchoid" flagellum, deeply excavated posteriorly, is characteristic of many Paussina II, but occurs in no other derivative paussids. The excavation is apparently not very stable. In a number of pairs of apparently related species the flagellum is conspicuously excavated in one but much less or not excavated in the other (*cf.* Figs. 77 & 78; 97 & 98; 99 & 100; 102 & 103).

It is likely that a conchoid flagellum something like that of *Enneapaussus howa* (Fig. 88), fused but originally with nine segments, has characterized a dominant group of paussids (the main stock of Paussina II) which has spread through Africa and the Orient and reached Madagascar, and that in each of these places one or more independent lines have lost all traces of segmentation and sometimes also the excavation of the flagellum. I cannot trace the exact lines of modification of the flagellum in Africa and the Orient, but they have probably been complex. In Madagascar, however, the situation is simpler.

It seems to me likely that, perhaps excepting *Enneapaussus howa* and certainly excepting *Bathypaussus jeanneli* (Reichensp.) (which represents another African group), all the 30-odd species of Madagascan paussids may be derived from one ancestor much like the existing African *Paussus cucullatus* (Fig. 75). Some

Madagascan species (*e. g. glabripennis* Jean., Fig. 89) still have an antennal flagellum like that of *cucullatus* except that the segmentation has disappeared anteriorly. Leading from this there is a fairly clear line of modification, with various side lines, toward loss of segmentation (Fig. 90), lengthening of the scape or first antennal segment (Fig. 91), and finally obliteration of the posterior excavation (Figs. 92–94). The main line ends in the endemic Madagascan genus *Anapaussus* (Figs. 92–94), in which both scape and flagellum are long, traces of segmentation are jumbled or absent, and the excavation is nearly or completely lost. In this case the excavation seems to have been opened out rather than closed, so that its upper posterior margin has become the anterior margin. I possess too few Madagascan paussids fully to confirm all this, but the species I do have are well distributed along the suggested phylogenetic line, and Jeannel's (1946) numerous figures of antennae of Madagascan paussids seem to fit into the pattern, allowing for side lines.

There remain unaccounted for various African and Oriental Paussina II in which the flagellum is bizarre in form (Fig. 82) or has lost most or all traces of segmentation and become uncommunicatively simple (Fig. 81). These forms are probably of complex origin.

Note the parallelism of form of antennae of various unrelated paussids (*cf.* Figs. 51 & 74, 53 & 59, 54 & 71, 72 & 85, 81 & 103).

The antennal setae and pubescence are variable in both the Ozaenini and the paussids. Some Ozaenini follow the normal carabid pattern: antennal segments 1–4 with a few stiff, apparently tactile hairs or setae, and 5–11 clothed with shorter, denser, more decumbent pubescence. This is the condition in the primitive Australian ozaenine genus *Mystropomus* and in a few other genera. In the ozaenine *Pseusozaena* the hairs of segments 1–4 are very short and can no longer be called setae, and in *Ozaena* and especially *Platycerozaena* the clothing of the whole antenna is reduced to a sparse scattering of short hairs. In the paussids the normal carabid condition is never found. In *Protopaussus* all the antennal segments are clothed with very short hairs, but some longer hairs, like short setae, are present too, especially on the outer segments. These hairs do not correspond to any of the usual fixed setae of Carabidae. The antennal pubescence of other paussids is extremely variable in distribution, density, erectness or decumbence, length, and form of hairs, but in no case (except *Protopaussus*), not even in *Carabidomemnus*, can I find antennal hairs that look like tactile setae. Rarely (*e. g.* in *Paussus boysi*) the antennae entirely lack pubescence.

The function of the peculiarly modified paussid antennae is a matter for speculation and future experiment. The antennae probably have an important function for, as wholes, they have not atrophied. On the contrary they are often excessively developed. In many cases they have become organs of secretion, with one or more trichomes, variously placed. In *Paussus sphaerocerus* Afz. they apparently produce light (Afzelius 1798, 261; Wasmann 1904, 27–28). And sometimes they are used as handles by ants which carry the paussids about. But these are probably incidental functions. The main function is suggested by the history of the second antennal segment. Reduction of this segment was the first main step in modification of the paussid antenna, as the Cerapterina show. The significance of this was pointed out to me by Prof. F. M. Carpenter, who reminded me that the second segment, or pedicel, of the insect antenna is the seat of Johnston's organ, which controls the antenna's tactile function (*cf.* Wigglesworth [1939], 135–6). The reduction of the second segment suggests that, in the paussids, the antennae are no longer tactile organs, and loss of the tactile function is suggested too by the awkward size and shape of many paussid antennae, which do not look like touching organs, and by absence of tactile antennal setae except perhaps in *Protopaussus*. Presumably the antennae have retained or assumed some other primary function, probably sensory, perhaps connected with finding the proper ants' nests or with receiving stimuli from ants. In any case the modification of the paussid antennae seems certainly to be an adaptation to myrmecophilous life.

Not only the modification of the antennae but also the disappearance of fixed (tactile) setae from the whole body and the apparent reduction of the tactile function of the maxillary palpi (see below) suggest that, compared to ordinary Carabidae, paussids lead relatively non-tactile lives.

Comb-organ.—The comb-organ or "*organe de toilette*" (Fig. 120), a comb of stiff hairs in an emargination of the inner edge of the front tibia, is present in most Carabidae but lacking in most paussids. So far as I know, the only other carabid that lacks it is *Nototylus* (Bänninger 1927, 177). But the organ is variable in Carabidae and varies considerably even within the Ozaenini (Bänninger *op. cit.*, 180 & 185, his Figs. 1-7; and my Figs. 120-122), being relatively weak in such genera as *Platycerozaena* (my Fig. 122) and in myrmecophilous *Physea* (Fig. 121); and, on the other hand, although it is absent in most paussids, traces of the comb-organ are still present in several primitive ones: in at least some *Protopaussus* (Fig. 123) and the cerapterines *Carabidomemnus* (Fig. 124), *Eohomopterus* (Fig. 126), and less distinctly in some *Arthropterus* (Fig. 125). In these a protibial emargination is present though broad and shallow, and is lined with short, rather fine hairs. The persistence of a remnant of the carabid comb-organ in a few primitive paussids does not necessarily indicate close relationship among the latter. *Protopaussus, Carabidomemnus,* and *Arthropterus* are not directly related genera, and in my opinion its emarginate front tibia does not indicate that *Eohomopterus* is directly related to any of the other genera named. The comb-organ may or may not be functional in these paussids. Its function in Carabidae apparently is to clean the antennae and especially their tactile setae. Its loss by most paussids is probably a result of, and a confirmation of, loss of the tactile function by the antennae, and so is to be considered a secondary result of the adaptation of paussids to life with ants.

Mouth-parts.—The mouth-parts of paussids are on the carabid plan, but are variously modified.

Their mandibles, compared with those of ozaenine Carabidae, are small and simple, but the labrum and especially the labium are often enlarged. In *Protopaussus,* in *Arthropterus* (Fig. 104) among the Cerapterina, and in *Pentaplatarthrus* the labium is small and the mandibles, though weaker than in the Ozaenini, are larger and more prominent than those of most paussids. In all the other Cerapterina I have seen, including in-some-ways-primitive *Carabidomemnus* and the American *Homopterus,* the labrum and labium are relatively long and, with the mandibles, form almost a short beak (Fig. 105). In the derivative paussids the labrum and labium are wide rather than long and tend to form a transverse, slit-like mouth (Fig. 106).

The maxillary palpi of ozaenine Carabidae (Fig. 107) consist of 2 fixed plus 4 free segments, but some of the segments near the base are hidden by the lateral lobes of the mentum; and the labial palpi consist of 1 fixed plus 3 free segments. In the paussids (Figs. 108-110) the fixed segments at least of the maxillary palpi are shortened and telescoped, and certain free segments, especially either the apical labial or the second maxillary one, are often enlarged or swollen or flattened.

Paussid palpi are diverse in detail. They have been much used in classification and often figured (*e. g.* by Raffray 1885, and Desneux 1905). I shall discuss them comparatively briefly. The 4 free segments of the maxillary and the 3 of the labial palpi seem to be present in all paussids. In some cases one or more additional segments are visible at the bases of the palpi, and these have sometimes been thought to be new, added segments. Actually, however, they seem to be merely the basal segments lettered in Fig. 107, modified, and exposed by partial atrophy of the mentum (*cf.* Figs. 107 & 110).

In *Protopaussus* both pairs of palpi are short and slender. In the Cerapterina the maxillary palpi are weak and slender; the labial ones, variable, with the apical segment slightly thickened in *Pleuropterus* (Fig. 108), more so in *Cerapterus,* and strikingly dilated in the other genera; and in *Homopterus* (Fig. 109) the subapical as well as the apical segment is very wide. In *Pentaplatarthrus* the maxillary palpi are slender; the labial ones, slightly thickened. In the derivative paussids (Fig. 110) the *maxillary* palpi are enlarged, with the second segment always largest and usually expanded and flattened, but variable in form; and the labial palpi are smaller, slender or dilated, and variable in proportion of segments in the different subtribes. In the Platyrhopalina the subapical and apical segments of the labial palpi are subequal and both much longer than the first segment. In the Ceratoderina the subapical segment is shorter than the apical one but much longer than the first. In the Paussina I the subapical segment is still shorter, usually little longer than the first, but considerably longer in a few species (*e. g. E. favieri* and *henningsi* R.). In the Paussina II the subapical segment reaches its shortest: it is often described as subequal to the first segment, but this is strictly true only in some cases (Fig. 110). It is more often slightly and sometimes considerably longer than the first segment (*e. g.* in *Anapaussus* and in *Paussus curtisi*).

The mentum of Carabidae (Fig. 111) is large, though variable. It is usually set off from the submentum by a distinct posterior suture which, however, is obliterated in a few diverse carabid groups (Horn 1881, 98). At the sides the suture ends at the lateral buccal sinuses. These sinuses are well developed in Carabidae and are filled by the outer edges of the maxillae and the bases of the maxillary palpi (Fig. 107). In my standard series of ozaenine Carabidae the mentum is always large though somewhat variable in detail; the posterior suture is always distinct; and the lateral buccal sinuses are always large. In the paussids (Figs. 112-119) the mentum is usually reduced in size and often pulled back or obliterated at middle; the posterior suture is sometimes obliterated; and the lateral buccal sinuses are sometimes closed. Note that the obliteration of the posterior suture occurs in only a few genera of paussids which, incidentally, are not directly related to each other (*Protopaussus, Pleuropterus,* and *Platyrhopalopsis*). The suture is present in other paussids. The statement found in some texts, that absence of this suture characterizes the " Paussidae ", is very far from correct. I shall describe the mentum of different paussids in some detail, because it has received comparatively little attention but yields very useful characters.

In *Protopaussus* (Fig. 112) the mentum itself is large and ozaenine-like, but the posterior suture is obliterated and the lateral buccal sinuses are closed posteriorly. In the Cerapterina the mentum takes two different forms. In *Carabidomemnus* (Fig. 113) and *Arthropterus* it is small and short but not otherwise much modified; the posterior suture is present; and the lateral buccal sinuses are wide. The mentum of *Pleuropterus* is similar except that the posterior suture is obliterated. The other form of the mentum in Cerapterina is found in *Cerapterus* (Fig. 114) and *Homopterus* (Fig. 115), in which the mentum is pulled far back or perhaps obliterated at middle (the sutures are difficult to identify), the lateral lobes are very long and slender, and the lateral sinuses are displaced or closed posteriorly. The similarity of the mentums of these two genera probably does not indicate direct relationship. In *Pentaplatarthrus* (Fig. 116) the mentum is large and carabid-like, except that the lateral sinuses are closed posteriorly. In the first subtribe of derivative paussids, the Platyrhopalina (Fig. 117), the mentum is large and not shortened at middle, and the posterior suture is present except in *Platyrhopalopsis.* In the other derivative paussids (Ceratoderina, Paussina I & II) the mentum is nearly or (usually) entirely obsolete at middle (Figs. 118–119), but the lateral lobes remain as widely separated processes marked off from the submentum by grooves which probably represent the posterior suture. The lateral buccal sinuses are open in all the derivative paussids.

Much more could be said about details of the mouth-parts of paussids, but the main points have been made. Paussids form two main groups according to their mouths. In one group, composed of all my "primitive" paussids, the mouth is either weakly carabid-like or slightly prolonged, and the maxillary palpi are simple, weak, and never closely fitted to the sides of the mouth, although the labial palpi are sometimes highly developed. In the other group, composed of all my "derivative" paussids, the mouth is transverse and the maxillary palpi are large and always closely fitted to the sides of the mouth. Other characters of the mouth-parts vary in both groups.

As to function, the weakly caraboid mouth, with small labium, of *Protopaussus, Arthropterus,* and *Pentaplatarthrus* seems simply predatory. The prolonged mouth of other Cerapterina and the transverse one of derivative paussids, both with larger labium, seem modified for special foods including liquids. The maxillary palpi have gone through a special course of evolution involving, first (in the primitive paussids), weakening and telescoping of the basal segments, and then, later (in the derivative paussids), enlargement of the free segments and fitting of them to the sides of the mouth. This suggests a change of function, beginning probably with reduction of the tactile function paralleling that of the antennae, possibly increase of sensory functions, and eventually assumption of the new mechanical function of closing and protecting the mouth. Other parts of the mouth, if not directly adapted to the special requirements of myrmecophiles, are probably changed as indirect results of adaptation. For example the closing of the lateral buccal sinuses in four independent stocks of primitive paussids but in no derivative stocks is probably an indirect result of the diminution of the maxillary palpi in the primitive paussids.

Legs.—The legs of Ozaenini are formed like those of ordinary Carabidae, except that in the myrmecophilous genus *Physea* the tibiae are rather wide and flat (Fig. 129).

Modification of the coxae and loss of the comb-organ of the front tibia in the paussids have already been discussed. The legs of most paussids are modified in other ways, often apparently for mechanical protection against ants, for movement in cramped quarters, or for rapid movement.

In *Protopaussus* (Fig. 130) the legs are not much changed from the carabid pattern.

In the Cerapterina, the tibiae (Figs. 131, 132) are moderately or much widened and flattened (except in *Pleuropterus*), and the tarsi (Figs. 133-134) are more or less cylindrical and in some cases shortened and partly retractile, and in *Homopterus* the tarsi are very short and entirely retractile into the hollow apices of the tibiae (Fig. 132). In *Pleuropterus* (Fig. 133) the tibiae are long and slender. It is surprising that this genus, which is in some ways the most derivative of the Cerapterina, has what seem at first glance to be primitive legs. But the legs are not really of a simple carabid type. The femora, though long, are relatively wide and flat near the base; and the tarsi, though moderately long and not retractile, are subcylindrical, except for the dilated segments. These details suggest that the legs of *Pleuropterus* are not primitive but are secondarily modified from the flattened form of other Cerapterina. There is a tendency in this subtribe for segments 2 and 3 of the tarsi to be larger than segments 1 and 4, the latter being especially small. This is most pronounced in the anterior tarsi of some *Arthropterus* and especially of *Pleuropterus* and *Cerapterus* (Fig. 134). *Eohomopterus* is said to have tarsal segments 3 and 4 very widely dilated (Fig. 135), but the original figure is crude and I suspect that it is really segments 2 and 3 which are dilated.

In *Pentaplatarthrus* the tibiae are moderately flattened and the tarsi (Fig. 136) are cylindrical but not retractile.

In the Platyrhopalina the tibiae are moderately or much widened and flattened, and the tarsi vary from rather flat to subcylindrical but are not retractile. In most Platyrhopalina the fourth tarsal segment is very small (Fig. 137); but the fourth segment is scarcely reduced in *Platyrhopalopsis* (Fig. 138). This character seems to reverse that of the antennae: in antennal structure *Platyrhopalus* seems primitive within its tribe; *Platyrhopalopsis,* derivative. If, however, the small fourth tarsal segment is inherited from the Cerapterina, *Platyrhopalopsis* may represent a return to the normal condition. So far as I know the fourth tarsal segment is not much reduced in any other derivative paussids.

In the other derivative paussids, especially in Paussina II, the tibiae and tarsi are extremely variable. The tibiae are usually more or less flattened or (less often) swollen, and both the femora and tibiae are sometimes very short and wide; and in *Hylotorus* (Fig. 6) they fit into shallow depressions on the lower surface of the body. In *Paussus klugi* and some other species the front and middle legs are scarcely expanded; the hind ones, very widely so (Fig. 141). This differentiation of legs appears also in some Madagascan *Paussus* (*e. g. scyphus* and *armicollis*) and is indicated even in some *Anapaussus* (in *elaphus* but not *dama*), suggesting derivation of the latter genus from a *Paussus* with differentiated legs. The tarsi of different Paussina are long or short, and the segments are flattened, sub-moniliform, or subcylindrical. They are never fully retractile, but when the tibiae are short and wide the tarsi tend also to be short and to fit closely against the ends of the tibiae. This brief survey gives an inadequate idea of the diversity of leg-structure of the Paussina. One of the furthest departures from the normal is *Anapaussus* (Fig. 5), in which the legs are astonishingly long and slender. This is obviously a secondary modification, recalling that of the cerapterine genus *Pleuropterus,* but more striking.

Each tibia has two spurs in normal Carabidae. The spurs are present in all Ozaenini, near the inner angle of the apex of all tibiae (Figs. 128, 129). In *Protopaussus* (Fig. 130) the spurs are missing or indistinguishable from the pubescence of the tibial apices. In the other primitive paussids (Cerapterina, Pentaplatarthrina) they are present. In the derivative paussids the spurs are present in the Platyrhopalina, absent in the Ceratoderina (Fig. 139), present in the Paussina I (Fig. 140) (22 species examined), and usually absent or indistinguishable in the Paussina II (Fig. 141) (25 species examined), the only exception I have found being *Paussus laetus,* in which small spurs are present on all tibiae in both sexes. The absence of tibial spurs in some paussids seems, incidentally, not to have been noticed before.

Secondary-sexual characters.—The external sexual characters of paussids are slight and inconstant (*cf.* Reichensperger 1948, 13). The males may be smaller than the females or may have wider front tarsi, or slightly larger eyes, or otherwise modified head, or longer or duller antennal flagellum, or relatively longer elytra, or differently shaped last ventral segment, or perhaps better developed wings or longer wing-vestiges, but all these characters hold only in some paussids. For example, the last ventral abdominal segment is entire in the male but emarginate at apex in the female in most Paussina (I & II) and also apparently in one genus of Cerapterina (*Homopterus*), but not in most other paussids; and even in the Paussina the character varies in development and fails in *Anapaussus,* in which both sexes have the last ventral entire or nearly so. In any serious study of paussids sex should always be determined by dissection.

Males seem to outnumber females in some paussids. Our material of the cerapterine genera *Homopterus, Cerapterus,* and *Pleuropterus* totals 31 males, only 4 females; of all Platyrhopalina, 18 males, 5 females; and of all Paussina I, 45 males, 11 females. In our Ceratoderina and Paussina II, however, the sexes are more evently represented. The excess of males in some groups may be a result of differences in habits. For example, males may fly to light more often than females and so may be collected more often. But Reichensperger (1949, 9) states that among more than 100 *Pentaplatarthrus gestroi* from one ants' nest, males outnumbered females in proportion of about 7 to 3, and this suggests a genetically unequal sex-ratio. In the groups of paussids with excess males the eyes are usually large, special glandular structures (trichomes etc.) are usually few or absent, and tibial spurs are present. In the groups with sexes more equal the eyes are usually smaller, glandular structures are more numerous and are rarely lost, and tibial spurs are absent. (Of course these are general correlations, not exact ones.) I cannot explain these correlations. They may be at least partly accidental, or they may reflect some fundamental differences in habits. The sex-ratio of paussids and its relation to structure and habits is a subject which needs for its study much material taken under known conditions. It would be a good subject for some entomologist living in the Old-World tropics.

Male copulatory organs.—The male copulatory organs (often called the male genitalia) of dry museum specimens of carabid and paussid beetles are best prepared for study by relaxing each specimen individually in hot water, cutting through the dorsal wall of the abdomen, dissecting out the organs in question from above, bringing them nearly to a boil first in 10% KOH and then in water, and finally putting them under a stereoscopic microscope and cleaning away superfluous tissue with fine forceps and a fine knife point. After study they may be preserved in glycerin in shell vials, and the latter may be pinned through the corks under the remounted specimens. To avoid later rusting of the pins, very little glycerin should be used and the pins should be put through the outer ends of the corks.

Carabid and paussid male copulatory organs consist of a middle lobe and two lateral lobes or parameres, and the middle lobe contains an eversible sac to which is attached the end of the ejaculatory duct. My drawings of these organs (Figs. 142–184), made of course with a camera lucida, stress the form of the middle lobe and especially of its apex, the position of the apical or subapical orifice, the presence of an internal movable rod, the form of the parameres (but their extreme bases and upper margins in basal half cannot always be shown accurately), and the presence or absence of hairs on the apices of the parameres. I have usually not attempted to show the eversible sac in detail. Its study would probably be informative, but is difficult and requires more and better material than I now have.

Genitalic characters are useful in two distinct ways: (1) to distinguish closely related species, and (2) to define higher groups and to work out phylogenies. It is chiefly for the second purpose that I shall use them here. They have already been used extensively by Jeannel (1941–42; 1946–) in his new classification of Carabidae. Unfortunately Jeannel did not use them in his classification of paussids (1946, 58–96); if he had done so, he would have avoided some mistakes. Ribeiro (1930) has figured the copulatory organs of several Indian genera, but until now no real use has been made of these immensely informative structures in paussid taxonomy.

Most entomologists, I suppose, now understand the nature of genitalic characters. They are not short-cuts to easy taxonomy. Good taxonomy has always been hard work, and the addition of genitalic characters to the old ones makes the work harder still, but better. Like any other characters, the genitalic ones have to be tested thoroughly. Like other characters, they are good where they hold, not good where they do not hold. For example, presence or absence of apical or fringing hairs on the parameres seems to hold as at least a generic character in the Ozaenini and in the paussid subtribes Paussina I and II, but as only a specific or even an individual character in the subtribe Platyrhopalina (see below).

In the Ozaenini (Figs. 142–144) the middle lobe of the male copulatory organs is short, stout, and relatively simple. Both the basal and the apical orifices vary somewhat in different genera: the apical orifice may be either truly apical or on either the left or the right side of the middle lobe slightly before its apex. Within the middle lobe, attached to the end of the eversible sac, is always (in this tribe) a long, stiff, moveable rod. The parameres of Ozaenini are usually very unequal: the left one is relatively short, broad, and glabrous; the right one, longer, more slender, and tipped or partly fringed with hairs. In *Physea* (Fig. 144), however, both parameres are glabrous.

In *Protopaussus* (Fig. 145) the apical orifice is on the right side of the angularly trough-like middle lobe; the internal rod is enormously developed; and both parameres are slender and glabrous. The parameres resemble those of *Paussus*, but this is obviously parallelism. The copulatory organs of *Protopaussus* seem as a whole to have evolved divergently. They are not intermediate between those of the Ozaenini and those of the primitive Cerapterina.

In the Cerapterina (Figs. 146–152) the copulatory organs are much like those of the Ozaenini, but show transition toward the derivative paussids in many ways. The middle lobe is short and stout in some of the cerapterine genera but more slender in *Cerapterus* and *Pleuropterus* (as in derivative paussids) and always more arcuate than in the Ozaenini (again as in derivative paussids). The basal orifice, which is variable in the Ozaenini, is always more or less ventral in the Cerapterina (and in all other paussids). The apical orifice, also variable in the Ozaenini, opens slightly to the left in *Carabidomemnus* but to the right in all other Cerapterina I have seen (and in all other paussids). In most Cerapterina the middle lobe has a variable but usually strong process (ventral in *Carabidomemnus pallidus* and *kirbyi* (Westw.), dorsoapical in *Homopterus*) or is deeply cleft at apex (*Cerapterus, Pleuropterus*). This cleft may be carried over as the apical emargination of the middle lobe of some higher paussids. The internal rod is long in *Carabidomemnus* and *Arthropterus,* shorter in *Cerapterus and Pleuropterus,* and vestigial in *Homopterus.* It is small or vestigial in all the higher paussids, but seems never to be completely lost. When fully developed, the rod probably helps to push out and pull back the eversible sac. What is the function of the rod when it is vestigial, and why the vestige is so persistent in the derivative paussids, I do not know. The parameres of different Cerapterina vary from broad (as in some Ozaenini) to rather slender (as in the higher paussids); they are comparatively little differentiated (again as in the higher paussids); and both are glabrous. In the absence of hairs from both parameres the Cerapterina differ from most Ozaenini but resemble *Physea.* (Hairs on the apices of the parameres are present in some, absent in other derivative paussids.)

In *Pentaplatarthrus* (Fig. 153) the middle lobe is rather slender, simple, with a deeply emarginate apex, and the parameres are only slightly widened and have pubescent tips.

Some characteristics of the male copulatory organs of the derivative paussids have already been noted in discussion under the Cerapterina, and the illustrations show the general appearance and comparative uniformity of the copulatory apparatus in each derivative subtribe.

The middle lobe varies a little in form in different derivative paussids. In the Platyrhopalina (Figs. 154–157) its apex is relatively wide and more or less (obliquely) subtruncate. In the Ceratoderina (Figs. 158–160) the middle lobe tends to be long and strongly arcuate, and a ventral process (for articulation of the parameres) lies close against its lower side at least in *Ceratoderus* and *Paussomorphus,* and a similar condition is suggested in *Merismoderus* by Ribeiro's figure (my Fig. 160). In the Paussina (Figs. 161–184) too, the middle lobe is slender and arcuate, but the ventral process stands out from it at a wide angle. Slight variations in curvature and in form of apex of the middle lobe of different Paussina II will be considered in discussion of groups within the subtribe, below.

The parameres of the derivative paussids are always slender, but are a little less so in the Platyrhopalina than in the others. They are usually subequal in length, but the right one is sometimes more or less reduced (*e. g.* in *Paussus microcephalus, cucullatus,* and *turcicus,* Figs. 169, 164, 176). The right paramere is especially variable in the Ceratoderina: in *Merismoderus* (Fig. 160) the two parameres are about equal; in *Ceratoderus* (Fig. 158) the right one is somewhat shortened; and in *Paussomorphus chevrolati* (Fig. 159) the right one is reduced to a triangular vestige (examined in 3 males). The apices of the parameres of different derivative paussids in some cases do, and in others do not bear hairs. In the Platyrhopalina and Ceratoderina the variation seems in some cases to be individual: one or two small hairs may or may not be present on one or both parameres at least in *Platyrhopalus angustus* (Fig. 154), *Platyrhopalopsis mellyi,* and *Ceratoderus oberthuri* (Fig. 158). In the platyrhopaline genus *Platyrhopalopsis* the hairs of the parameres may be a specific character: in 3 males of *P. mellyi* the parameres are glabrous or have only 1 or 2 small hairs at apex, but in 3 of the very similar *P. picteti* Westw. both parameres have a definite apical fringe of several hairs. In the Paussina the presence or absence of definite groups of hairs on the apices of the parameres seems to be a more important character. It will be discussed in detail in due course.

Retractile styles of female.—The paired retractile styles of the female (Figs. 185–206) are comparatively simple plates which are not limited by surrounding sclerites. They can therefore vary enormously in shape, and they do so in both the Ozaenini and the paussids. The variations are probably not of deep phylogenetic significance, but they do sometimes yield useful characters. In the paussids, for example, they sharply distinguish the females of such superficially similar genera as *Carabidomemnus* and *Arthropterus,* and they distinguish and support the naturalness of the new subtribes Platyrhopalina and Ceratoderina.

I do not know the female of *Protopaussus.*

In the Cerapterina the styles have a different, characteristic form in each genus known to me, and the differences are astonishingly great. I have summarized them in a key (p. 95) which, it should be noted, is for convenience only, and does not group the genera according to their probable relationships.

In *Pentaplatarthrus* (Fig. 190) the styles are much like those of *Pleuropterus.*

In the Platyrhopalina (Figs. 191–194) the styles are relatively simple, without setae. I have seen only one female of each genus of this subtribe, and the styles are damaged in some of them, so I cannot discuss the genera individually.

In the Ceratoderina (Figs. 195–197) the styles are obliquely subtruncate (*Merismoderus*) or with expanded, plate-like apices (*Ceratoderus* and *Paussomorphus*); the apices are bent away from the body; and the setae are dorsal.

In the Paussina (I & II) (Figs. 198–206) the styles are relatively long and slender; the apices are bent toward the body; and the setae are external. There is surprisingly little variation in the styles of different Paussina, even less than the drawings suggest. The apices are always bent away from the body. Whether they are directed slightly toward each other or apart depends more on their position (they are movable) than on any difference in shape.

PHYLOGENY

Ozaenine Carabidae and paussids are basically similar, and comparison of the details of their structure leaves no reasonable doubt that the paussids are derived from the Ozaenini. The following principal differences have been found between the two groups. Most Ozaenini are probably not myrmecophilous, and all paussids probably are, at least as larvae; but the ozaenine genus *Physea* is myrmecophilous. As compared with ordinary carabid larvae, known paussid larvae are notably degenerate; but the larva of the myrmecophilous ozaenine *Physea* is intermediate. A raised elytral margin is always present in Ozaenini, always absent in paussids; but the margin is weak in *Ozaena* and is obliterated in some other, very convex Carabidae. The median cell of the wing is quadrangular in Ozaenini, triangular in most paussids; but *Protopaussus* still has a quadrangular cell, and a partial transition to the derivative paussid cell occurs in the paussid subtribe Cerapterina. Normal fixed setae are present in most Ozaenini, absent in all paussids; but the setae are partly or completely absent in some Ozaenini. The front coxae are low and separated by a prosternal process in Ozaenini, usually prominent and contiguous in paussids; but *Protopaussus* matches the Ozaenini in this respect, and another paussid genus, *Carabidomemnus,* is intermediate. The hind coxae are slightly separated in most Ozaenini, contiguous in all paussids; but they are virtually contiguous in the ozaenine *Physea* and fully so in most non-ozaenine Carabidae. The first three ventral segments are less fused in the Ozaenini than in the paussids; but there is no real difference in ventral pattern. The pygidium is covered by the elytra in most Ozaenini, exposed in most paussids; but it is exposed in the cylindrical ozaenine *Dhanya* and in many non-ozaenine Carabidae, and it is more or less covered in a few paussids. Trichomes and special (myrmecophilous) glands are absent in the Ozaenini and in Carabidae in general, present in most paussids; but they are primitively absent in most cerapterine paussids and secondarily absent in some derivative ones. The antennae are simply 11-segmented in the Ozaenini, less than 11-segmented and otherwise modified in most paussids; but *Protopaussus* still has 11 fully developed antennal segments, and transition to a smaller number occurs in the Cerapterina. The comb-organ of the front tibia is present in all Ozaenini, absent in most paussids; but it varies in different Ozaenini, and a vestige of it remains in a few primitive paussids. As compared with the Ozaenini, paussids have weakened or otherwise modified mouths; but there is no fundamental difference in structure. The legs are unspecialized in most Ozaenini, flattened or otherwise modified in most paussids; but there are exceptions in both groups. The left and right parameres of the male copulatory organs are strongly differentiated in most Ozaenini, much less so in paussids; but the ozaenine *Physea* resembles the primitive paussids in this respect. The male copulatory organs of Ozaenini and of paussids differ in other minor ways; but transition is clear, and the difference between some Ozaenini and some cerapterine paussids is not great.

In general, paussids differ from ozaenine Carabidae in conspicuous adaptive characters (*e. g.* development of glandular organs, extreme modification of antennae) which, however, do not hold completely, and in less conspicuous, in some cases apparently non-adaptive (or non-myrmecophilous) characters, of which some do not hold either, and the rest (*e. g.* obliteration of the elytral margin) are rather superficial. This suggests that paussids have evolved as myrmecophilous insects under strong selective pressure, so rapidly that comparatively little non-adaptive modification of the original ozaenine stock has occurred and that many ancestral and annectant forms still survive.

Although paussids are diverse in many ways, they have probably all been derived not only from the Ozaenini but from a single ozaenine which can be reconstructed in some detail. The elytra of the ancestral form probably lacked raised external margins, and the pygidium may have been exposed (these were perhaps at first superficial characters associated with cylindrical body-form); tactile setae had probably disappeared from the body; the posterior coxae were probably contiguous; the first three ventral segments were perhaps more closely connected than usual; and the parameres of the male copulatory organs were probably less differentiated than usual. These characters, at least some of which seem to be non-adaptive or non-myrmecophilous, are unknown or exceptional among existing Ozaenini but (except for the exposed pygidium) universal among paussids, and are the basis of my conclusion that all paussids are derived from one ozaenine. No such ozaenine now exists, but if it did, and if paussids were unknown, it would not be considered a particularly remarkable member of its tribe.

The ancestral ozaenine stock presumably became myrmecophilous and underwent a resultant adaptive evolution. The mouth was modified by weakening of the mandibles and maxillary palpi, and in other ways; and the antennae began to lose or change function and to change form, and as a result the comb-organ of the front tibia was reduced. During these processes, and before the completion of some of them, the ancestor of *Protopaussus* split off from the main stock. The latter, after further modification of the antennae (especially reduction of the second segment), reduction of the prosternal process, and change in shape of the median cell of the wing (the latter hardly an adaptation to myrmecophilous life), became the Cerapterina.

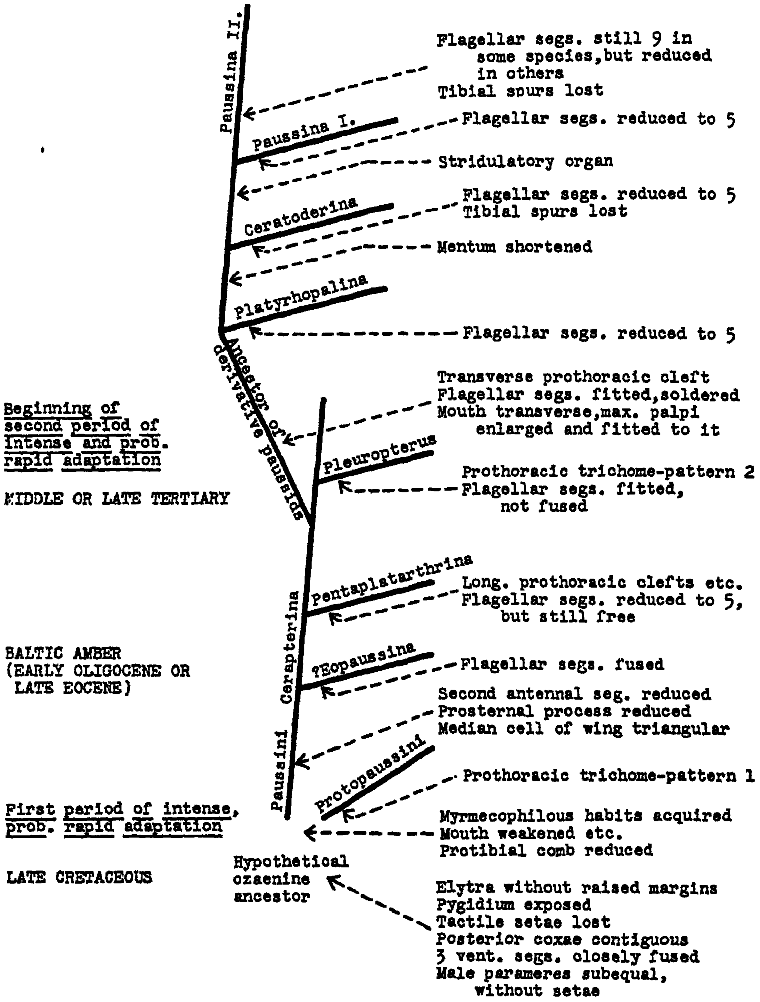
The first cerapterines, like most existing ones, probably lacked special glandular organs, but in the course of time three different cerapterine stocks apparently originated different prothoracic trichome-systems. One stock evolved trichomes in a pair of more or less longitudinal prothoracic clefts, and on the pygidium; and its antennal flagellum was reduced from 9 to 5 segments which, however, remained movable. It became the Pentaplatarthrina. Another stock evolved basal prothoracic and adjacent basal elytral trichomes; and its flagellar segments, though not reduced in number, were closely fitted together, but still movable. It became the existing genus *Pleuropterus*. The third stock (but perhaps not the last in point of time) evolved trichomes in a transverse prothoracic cleft; its flagellar segments were not reduced in number but were probably first fitted together as in *Pleuropterus* and then soldered together; and its mouth became transverse, with the maxillary palpi enlarged and fitted to it at the sides. This stock was probably the common ancestor of the derivative paussids. This cerapterine ancestor of the derivative paussids was probably closest to (of existing genera) *Cerapterus* and *Pleuropterus*, which are probably related to each other. Its palpi were probably relatively undifferentiated, as are those of *Cerapterus* and *Pleuropterus*, and so capable of specialization in a new direction. Its mentum, like that of *Pleuropterus*, was probably large and not retracted, but with the posterior suture not obliterated. Its antennae were probably at one stage like those of *Pleuropterus*, with the flagellar segments fitted together but not fused (but this was a matter of parallelism rather than relationship). The middle lobe and parameres of the male copulatory organs were probably relatively slender, like those of *Cerapterus* and *Pleuropterus.* The female styles were perhaps without setae, like those of *Cerapterus.* And the fourth tarsal segment was probably small. The last two characters (styles without setae, small fourth tarsal segment) were apparently carried over into the first subtribe of derivative paussids (Platyrhopalina), then lost.

From such an ancestor the first derivative paussid subtribe (Platyrhopalina) probably arose as a side-line, marked by reduction of the flagellum from 9 to 5 segments. In this side-line the transverse prothoracic cleft has been reduced to a groove or suture in all existing forms; and in some forms the flagellar segments, at first merely soldered together, have been progressively fused. The main line, after a shortening of the mentum and some other evolution, probably next set off the Ceratoderina as another side-line, marked by another reduction of the flagellum from 9 to 5 segments, with other modifications following. The main line probably then, after still further evolution and development of the ventral stridulatory apparatus, set off the Paussina I, marked by still another reduction of the flagellum from 9 to 5 segments, followed by other changes. Finally the main line itself radiated as the Paussina II from a central form with a still-9-segmented, excavated flagellum. During this whole course of evolution other structural changes were proceeding. For example, the second segment of the labial palpi was progressively reduced, and the middle lobe of the male genitalia evolved a very slender, arcuate form and a baso-ventral process. The "side-lines" tended to preserve successive stages in the evolution of these and other structures, as well as to evolve new structures of their own.

This is, I think, the simplest probable phylogeny of the derivative paussids. It would not be simpler to derive the subtribes with 5-segmented flagellum from each other rather than independently from a 9-segmented main line; for this would necessitate a fantastic amount of parallelism of structures other than the flagellum. It would indeed be simpler, but less probable, to make a 5-segmented series the main line of evolution and to derive the Paussina II from it by a back-mutation from 5 to 9 flagellar segments. This is theoretically possible, but not probable. It would be against the whole main course of evolution of the paussid flagellum.

The apparent main course of paussid phylogeny is shown on the accompanying diagram (page 82). The diagram is, of course, much too simple. Paussid evolution has not proceeded in a straight line with occasional simple side-lines, but probably by successive, complex radiations of increasingly derivative forms. Moreover the diagram is based on only a few significant characters, not even including the genitalic ones (which, however, fit in very well). It is actually not so much a picture of the path of evolution as a plan of the sequence of a few selected evolutionary events that have occurred among paussids. In this sense the diagram is, I think, somewhere near the truth.

The amount of parallel evolution and of regression that has occurred in the paussids is impressive. Main prothoracic trichome-systems seem to have originated independently four times, and there is no counting the number of times minor trichomes have originated on the antennae and other parts of the body. On the other hand, the transverse trichome-bearing cleft of the derivative paussids has atrophied at least four times, and minor glandular structures have atrophied innumerable times. Frontal horns have originated independently at least once in African *Edaphopaussus* (Paussina I) and once in Malayan *Paussus* (Paussina II). The antennae of different paussids have repeatedly evolved striking parallelisms of form, and the parallelism that has occurred in loss of structure of antennae is still more striking. The flagellum seems to have been reduced from 9 to 5 segments at least four times, in four different subtribes, and a more gradual fusion of segments has occurred many times. Extreme widening and flattening of the legs has occurred independently in probably several different genera of Cerapterina, and in *Platyrhopalopsis,* some *Paussus,* and *Hylotorus;* and return to a secondarily slender-legged condition has apparently occurred at least twice, in *Pleuropterus* and *Anapaussus.* In the latter there has apparently occurred also a return from a condition in which the middle and hind legs were strongly differentiated to one in which they are nearly alike again. The fourth tarsal segment has perhaps been reduced only once (in the Cerapterina), but it may have been re-


Paussina II.
Paussina I.
Ceratoderina
Platyrhopalina
Ancestor or derivative paussids
Pleuropterus
Pentaplatarthrina
?Eopaussina
Protopaussini
Cerapterina
Paussini
Flagellar segs. still 9 in some species, but reduced in others
Tibial spurs lost
Flagellar segs. reduced to 5
Stridulatory organ
Flagellar segs. reduced to 5
Tibial spurs lost
Mentum shortened
Flagellar segs. reduced to 5
Transverse prothoracic cleft
Flagellar segs. fitted, soldered
Mouth transverse, max. palpi enlarged and fitted to it
Prothoracic trichome-pattern 2
Flagellar segs. fitted, not fused
Long. prothoracic clefts etc.
Flagellar segs. reduced to 5, but still free
Flagellar segs. fused
Second antennal seg. reduced
Prosternal process reduced
Median cell of wing triangular
Prothoracic trichome-pattern 1
Myrmecophilous habits acquired
Mouth weakened etc.
Protibial comb reduced
Elytra without raised margins
Pygidium exposed
Tactile setae lost
Posterior coxae contiguous
3 vent. segs. closely fused
Male parameres subequal, without setae
Hypothetical ozaenine ancestor
Beginning of second period of intense and prob. rapid adaptation
MIDDLE OR LATE TERTIARY
BALTIC AMBER (EARLY OLIGOCENE OR LATE EOCENE)
First period of intense, prob. rapid adaptation
LATE CRETACEOUS

Phylogenetic diagram. Selected, significant events in the evolution of tribes and subtribes of paussids. See text for further explanation.

enlarged in three different stocks (Pentaplatarthrina, *Platyrhopalopsis,* and the line of the other derivative paussids). Tibial spurs have been lost probably three times. The posterior suture of the mentum has been obliterated three times. The inner wings have been reduced at least three times (as they have been probably hundreds of times in other carabids). And setae have appeared or disappeared on the male parameres several times (setae have probably appeared independently in the Pentaplatarthrina, some species of *Platyrhopalopsis,* and the Paussina I); and setae have apparently been lost and regained on the female styles at least once. To avoid these cases of parallelism and regression by changing paussid classification would in almost every case necessitate assuming much more parallelism of other structures. The amount of parallelism and regression suggested above is close to the absolute minimum that must have occurred during the evolution of the structures in question. These cases make an imposing list, but they are perhaps no more than samples of the kind and amount of parallelism and regression that have occurred in the evolution of paussid structures, and probably also of paussid habits.

The parallelism of structure which appears so often in the paussids is presumably usually a result of parallel adaptation, but in some cases it may be due to mutational effects. For example, an apparently primarily 5-segmented flagellum characterizes four subtribes of paussids which are probably not directly related to each other: the primitive Pentaplatarthrina and three subtribes of derivative paussids. This may be a result of recurrent mutation.

A single mutation acting on a segmented organ may affect it in any of several ways. It may, among other things, eliminate single segments, or halve the number of segments, or halve the number of divisions between segments. A single mutation of the last sort, acting on the original 9-segmented paussid flagellum presumably in the embryo, would cut the number of cross sutures from 8 to 4, reducing the segments from 9 to 5, and such a mutation might recur in different stocks. (Prof. P. C. Mangelsdorf tells me that this is a reasonable genetic possibility.) The state of affairs among the paussids suggests that the flagellum has indeed been reduced in two ways: in the Pentaplatarthrina and each of the first three derivative subtribes, by mutation from 9 to

5 segments, followed by progressive fusion in the derivative forms; but in Paussina II, by elimination or fusion of successive single segments or irregular numbers of segments. Parallel mutation is probably involved also in wing-atrophy and perhaps in other details of paussid evolution or devolution.

FOSSIL PAUSSIDS

Fossil paussids are known only from Baltic amber. Supposed paussids from the Miocene of Colorado (*Paussopsis:* Cockerell 1911; Wickham 1912) are not paussids according to Wasmann (1929, 10–11), and I agree with him. Wasmann (*l. c.*) has corrected some other errors involving supposed or real fossil paussids, but was probably wrong himself in the case of one Baltic amber form, *Paussoides* Mots. (Wasmann 1929, 49–50). The antenna of *Paussoides* has a stem of three small segments and a 4-segmented club. No paussid has such an antenna or anything like it. I do not know what *Paussoides* is, but it is probably not a paussid and certainly not related to *Lebioderus* as Wasmann thought.

Wasmann (1929), in his revision of the paussids of the Baltic amber, recognized 7 genera, 2 additional subgenera, and 20 species. These forms fall in my scheme of classification as shown in Table 2.

TABLE 2. *Baltic Amber Paussids, after Wasmann* (1929), *but with Tribal and Subtribal Headings Suggested in the Present Paper* (*Groups Marked † Are Extinct*)

"Primitive paussids"
  Tribe Protopaussini: none
  Tribe Paussini
    Subtribe Cerapterina
      †Genus *Arthropterillus:* 3 species
      Genus *Arthropterus* (*s. s.*): 9 species
        †Subgenus *Pleuarthropterus:* 1 species
        †Subgenus *Acmarthropterus:* 1 species
      †Genus *Cerapterites:* 1 species
      †Genus *Protocerapterus:* 2 species
      †Genus *Arthropterites:* 1 species
    †Subtribe Eopaussina
      †Genus *Eopaussus:* 1 species
"Derivative paussids": none
Not a paussid: †*Paussoides:* 1 species

A better taxonomist than Wasmann might have made fewer genera and species of the amber paussids—most of the species are based on single specimens—but there do seem to be several different forms. Without seeing the specimens I cannot revise them in detail. However, I doubt almost everything that Wasmann says about relationships of genera. He puts a number of the amber forms in the existing genus *Arthropterus,* which is now confined to the Australian Region. Some of them may be *Arthropterus,* but Wasmann did not prove it. The fossil and Recent forms should be re-compared with more attention to the mentum, labium, and other mouth parts, the front coxae, the tarsi, and the apex of the male middle lobe and female styles if by any lucky chance these structures are visible. In the mean time the assignment of the amber forms to *Arthropterus* must be doubtful. This is not just a technical doubt. After careful examination of the photographs, and considering the important hidden differences among such superficially similar existing genera as *Arthropterus, Carabidomemnus,* and subgenus *Arthropteropsis* of *Homopterus,* I seriously doubt whether any of the amber specimens is *Arthropterus.* This genus seems in some ways (apparent non-myrmecophilous habits of adults, small size of labium, frequent atrophy of wings) to be a retrograde genus such as might reasonably be supposed to have originated in, and always been confined to, an isolated area such as the Australian Region.

In some of the amber cerapterines, notably *Cerapterites* (Wasmann's Fig. 25), the profile suggests that the front coxae are low as in the African *Carabidomemnus.* The fossil *Protocerapterus* (Wasmann's Fig. 28) has very broad tibiae and very short, apparently retractile tarsi such as occur among living paussids only in the American *Homopterus.*

Of the amber Cerapterina as a whole I should say that they surely represent this subtribe but that their relationships to existing genera are doubtful. There are indications either of several stocks related to different existing genera including African and American and possibly Australian ones, or of one stock with a combination of characters not found in any existing genus but from which various existing forms may have been derived.

Eopaussus (Wasmann *op. cit.,* 50-58, his Figs. 35-44), known from one fairly well preserved specimen, is the only non-cerapterine paussid in the Baltic amber. Its antennae are highly modified, with the flagellum apparently fused into a single mass and bearing secretory organs; but both pairs of palpi are said by Wasmann to be simple and cylindrical, the maxillary pair not taking part in closing the mouth. In this, *Eopaussus* differs from all existing "derivative" paussids, and it is further differentiated from them by apparent lack of a transverse prothoracic cleft or suture and by presence of an apparent prosternal process separating the front coxae. This last character, if it really exists (it is mentioned by Wasmann and is suggested in the photographs), places the origin of *Eopaussus* far back near the beginning of paussid evolution. I feel some doubt about the real structure of this insect. If it is as described, it probably represents an early cerapterine stock, derivative in antennal structure but primitive in other ways. I have placed it accordingly in the phylogenetic diagram, and have tentatively assigned it to a subtribe of its own.

The fossil paussids of the Baltic amber supply no missing links in the evolution of existing paussids, but they are very informative in another way. They show that there was a paussid fauna in northern Europe late in the Eocene or early in the Oligocene which consisted almost entirely of Cerapterina and which apparently lacked all existing groups of derivative paussids.

The exact geological age of the paussids is unknown, but several lines of evidence bear on it.

The absence of derivative paussids in the Baltic amber suggests that the derivative subtribes evolved later than the time of deposition of the amber (late Eocene or early Oligocene). If so, and considering that the derivative paussids differ from some primitive ones much more than the latter differ from Ozaenini, there may have been time for the paussids to originate and evolve entirely within the Tertiary.

The paussids are and probably always have been an essentially myrmecophilous group—the whole main course of their evolution is one of adaptation to life with ants. They can hardly be older than ants; in fact they can hardly be older than the rise of ants as dominant social insects; and ants are unknown before the

Tertiary. This evidence is negative, but real. Something like eleven thousand individual ants have been found in the Baltic amber; none, in a large, insect-bearing collection of apparently Cretaceous amber from Canada; and none, anywhere else before the Tertiary (F. M. Carpenter, personal communication). This does not prove that ants did not exist in the Cretaceous, but it does strongly suggest a great change in ants and ant faunas between the Cretaceous and the fairly early Tertiary. Moreover paussids apparently do not occur with the most primitive sorts of ants (none is recorded with any Ponerinae, Dorylinae, or Pseudomyrminae), but only with intermediate or higher groups, and this again is consistent with a rather recent origin of paussids. (I am indebted to Mr. W. L. Brown for information about ants and for ideas about their history.)

The geographical distribution of paussids suggests a fairly recent origin and evolution. The derivative paussids far outnumber the primitive ones in Africa and the Oriental Region, but have not reached Australia or America. Probably they evolved too late to be able to do so. However, the presence of at least one peculiar stock of Cerapterina in South America indicates existence of this primitive subtribe at the very beginning of the Tertiary, before South America began its long period of isolation.

The facts and deductions of the three preceding paragraphs suggest that the paussids originated late in the Cretaceous, and that the derivative subtribes evolved in the middle or late Tertiary.

Analysis of their pattern of evolution suggests something more about the history of paussids. They have apparently "evolved as myrmecophilous insects under strong selective pressure, so rapidly that comparatively little non-adaptive modification of the original ozaenine stock has occurred and that many ancestral and annectant forms still survive" (p. 78). This in itself suggests evolution in a rather short time, and the analysis can be carried further.

The male copulatory organs and female styles of paussids are adapted to their functions, but not to the beetles' special environment. In the latter sense they are non-adaptive structures. Among the older, primitive paussids these structures have evolved great differences distinguishing nearly every genus; among the more recent, derivative paussids, much smaller differences; and within the subtribe Paussina II, practically no significant differences at all. These non-adaptive structures have apparently evolved more or less regularly, in proportion to time.

The trichomes and modified antennae of paussids, on the other hand, seem directly related to the myrmecophilous environment. These structures are moderately diverse among the older, primitive paussids, but (especially the antennae) very much more diverse among the more recent, derivative ones. These adaptive structures have apparently evolved irregularly and sometimes very rapidly.

The male copulatory organs and female styles of insects are usually not conservative in evolution. That, in the derivative paussids and especially in the Paussina II, they have differentiated so little while the directly adaptive external structures have differentiated so much (*cf.* the figures of the male copulatory organs and those of the antennae of Paussina II, Figs. 164–184 and 74–103) suggests that the evolution of the derivative paussids has been "explosively" rapid. This is consistent with the indication of the fossil record, that the derivative paussids have evolved since the time of the Baltic amber. And, by analogy, it suggests also that the slight adaptive changes of the mouth, antennae, etc. that marked the origin of paussids may have occurred rapidly. In other words, if the last part of paussid evolution has been rapid, the beginning is likely to have been rapid too. Accordingly, on the phylogenetic diagram (p. 82), I have suggested two periods of rapid adaptive evolution, the first during the origin of paussids late in the Cretaceous, the second during the evolution of the derivative paussids in the middle and late Tertiary.

TAXONOMY

Phylogenetically, the paussids are closer to the Ozaenini than the latter are to any other Carabidae. They can hardly be maintained as a separate family, unless one wishes to raise many other carabid groups to family rank. Jeannel (1942–43; 1946–) has done this in his new classification of carabids, and has in fact divided the old "Carabidae" into about fifty small families, but I do not care to follow him in this. My reasons will be given in detail elsewhere. In my own work I plan to accept much of the framework of Jeannel's classification but to simplify it, preserve the family "Carabidae" in its pre-Jeannel sense, and preserve also the conventional tribes so far as consistent with new facts.

In my modification of Jeannel's classification, the paussids form two tribes of the division Isochaeta of the family Carabidae. The Isochaeta differ from all other Carabidae in having both spurs of the front tibia apical, when present. This is probably a primitive condition. The Isochaeta have also an apparently primitive, but not unique, ventral structure, in which the mesepimera reach the middle coxal cavities, except perhaps in *Nototylus* (*cf.* Bänninger 1927, 177). The division contains only a few tribes, which, except in the characters given, differ greatly among themselves. They are apparently phylogenetic relicts of various primitive groups, and most of them are geographical relicts too, as the list below shows. Of these tribes, probably only the Ozaenini and the two paussid tribes are closely related among themselves. This relationship might be shown by putting the Ozaenini and the paussids together in a subfamily, but that would logically require the creation of separate subfamilies for each of the other tribes. It seems better, at least for the time being, just to state the relationship rather than to force it into the classification. For convenience, the Ozaenini and the paussids may together be called the Ozaenine Complex.

The modification of Jeannel's classification of Carabidae that I suggest, so far as it concerns the paussids, is given in the accompanying table (Table 3). *Protopaussus* does not fit well into either the Ozaenini or the Paussini, which are well characterized, homogeneous tribes. It is therefore given independent tribal rank. Actually, of course, it is not intermediate between the Ozaenini and the Paussini proper, but represents a side line marked by a peculiar prothoracic trichome-system, distinctive male genitalia, and other characters. The last two tribes of the table, Nototylini and Cicindisini, are not mentioned by Jeannel and were perhaps unknown to him, as indeed they are to me, except from the literature. They are placed in the Isochaeta on the strength of Bänninger's descriptions of tribal characters.

TABLE 3. *Partial Classification of the Family Carabidae (Revision of a Part of Jeannel's Classification)*

Division Isochaeta
  Tribes of the Ozaenine Complex
    Ozaenini: various genera, in all principal tropical and some warm-temperate regions
    Protopaussini: only *Protopaussus,* of the Oriental Region
    Paussini: various subtribes and genera, in all principal tropical and some warm-temperate regions
  Other tribes
    Metriini: only *Metrius,* of western North America
    Trachypachydini: only *Trachypachys,* of northern Eurasia and western North America, and *Systolosoma,* of Chile
    Gehringiini: only *Gehringia,* of western North America
    Nototylini (Bänninger 1927, 177): only *Nototylus,* of Brazil
    Cicindisini (Bänninger 1925, 181–182; 1927, 177; 1927a): only *Cicindis,* of Argentina and the Gulf of Persia (!)
Other Divisions (Anisochaeta)
  All other Carabidae

The tribes of the Ozaenine Complex are conveniently distinguished from all other Isochaeta by the subapical elytral fold (Figs. 19–21), which occurs in no other Carabidae, so far as I know. They are distinguished among themselves by clear and significant characters given in the following key.

Key to Tribes of the Ozaenine Complex

1. Antennae each with 11 normally developed segments, the flagellar ones moniliform, short-cylindrical, or slightly flattened; front coxae not much projecting, separated by a normal prosternal process; median cell of wing quadrate 2

Antennae with less than 11 normally developed segments, the 2nd segment strongly reduced or vestigial, the flagellar ones strongly flattened, expanded, or soldered or fused together; front coxae slightly or (usually) strongly projecting, usually contiguous (separated by a thin prosternal septum in some *Carabidomemnus*); median cell of wing triangular or reduced 3

2. Elytron with raised lateral margin; trichomes absent; mouthparts not much modified ....OZAENINI

Elytron without raised lateral margin; trichomes present (on prothorax); mouth-parts modified as described in text ...PROTOPAUSSINI

3. (Elytron without raised lateral margin; trichomes often present; mouth parts modified as described in text) ....PAUSSINI

The classification of paussids among themselves has long been based chiefly on characters of the antennae and palpi (*cf.* Desneux 1905). Jeannel (1946) stresses the antennae even more, which is a step in the wrong direction. I plan to discuss Jeannel's work on paussids in a review of his *"Coléoptères Carabiques de la Region Malgache"*. Instead of detailing criticisms here, I shall proceed at once to suggest a partly new classification based on a variety of characters.

After placing *Protopaussus* in a separate tribe, I see no reason to divide the Paussini formally at more than one level above the genus. I shall, therefore, merely propose the six subtribes named in the following key. Some of the subtribes are better defined than others, and some might be grouped against others, as I have informally grouped the "primitive" against the "derivative" ones, but it seems to me that these are primarily phylogenetic arrangements and that there is nothing to gain by forcing them into the formal taxonomic system. I agree with Simpson (1945, 12–13) that taxonomy should be consistent with phylogeny but that it should not and cannot reflect phylogeny in great detail.

Key to Subtribes of the Tribe Paussini Based on Non-genitalic Characters

[***Primitive paussids, with no*** transverse ***prothoracic cleft nor vestige of it, with antennal flagellar segments free, mouth weakly caraboid or slightly prolonged, maxillary palpi relatively weak and not fitted to the sides of the mouth***]

1. Antennae with 10 well-developed free segments (9 in flagellum); prothorax without trichome-bearing clefts and without vestiges of them (but with basal trichomes in *Pleuropterus,* Fig. 33) .....CERAPTERINA

Antennae not as above; prothorax with trichome-bearing clefts or vestiges of them 2

2. Antennae with 6 free segments (5 in flagellum); prothorax with a more or less longitudinal trichome-bearing cleft on each side anteriorly (Fig. 34) ....................................PENTAPLATARTHRINA

[***Derivative paussids, with transverse prothoracic cleft or vestige of it, with antennal flagellar segments soldered or fused together, mouth transverse, maxillary palpi relatively large and fitted to the sides of the mouth***]

Antennae with variable number of segments but with the flagellar ones soldered or fused together; prothorax with a transverse trichome-bearing cleft or vestige of it (Figs. 35–37) 3

3. Mentum large, long at middle; 4th tarsal segment often small; (flagellum never with more than 5 segments indicated, sometimes fused into a single mass) .... PLATYRHOPALINA

   Mentum small, very short or obliterated at middle; 4th tarsal segment not small 4

4. Ventral stridulatory file absent; (flagellum never with more than 5 segments indicated, sometimes fused into a single mass) .. CERATODERINA

   Ventral stridulatory file present (Paussina *s. lat.*) 5

5. Tibial spurs present; prothorax relatively simple (Fig. 35), with sides usually not angulately prominent before the cleft, and with the latter often reduced to a groove or suture without trichomes; antennal flagellum lens-shaped or slightly modified from a lens-shaped form (Figs. 62–73), never excavated, rarely with projecting processes or teeth (flagellum never with more than 5 segments indicated, sometimes fused into one homogeneous mass) (See also Table 4) .. PAUSSINA I

   Tibial spurs usually absent (but present in *Paussus laetus*); prothorax usually more complex (Fig. 36), deeply cleft, with sides usually angulately prominent before the cleft, and with the latter only rarely (only in some *Hylotorus*?) much reduced and without trichomes; antennal flagellum variable (Figs. 74–103) but usually not simply lens-shaped, usually with a posterior excavation or trace of it, often with projecting processes or teeth (flagellum often with more than 5 segments indicated, but also often with fewer, and sometimes fused into one homogeneous mass) (See also Table 4) .... PAUSSINA II

This key can be reinforced at almost every point by characters of the male copulatory organs and female styles, but these characters are most important among the derivative subtribes, in which there has been so much parallelism of antennae and other structures. I give, therefore, the following genitalic key to the derivative subtribes only.

Key to Subtribes of Derivative Paussids Based on Male Copulatory Organs and Female Styles
(*cf. Figs. 154–184, 191–206*)

1. Male middle lobe without an abrupt sub-basal protuberance; female styles without setae .... PLATYRHOPALINA

   Middle lobe with an abrupt sub-basal protuberance for articulation of the parameres; female styles with setae 2

2. Sub-basal protuberance lying close against the lower side of the middle lobe; female styles subtruncate or produced as thin plates, bent away from the body, with setae dorsal .... CERATODERINA

Sub-basal protuberance standing out from the middle lobe at a wide angle; female styles slender, bent toward the body, with setae external (Paussina *s. lat.*) 3

3. Both male parameres tipped with several hairs ....PAUSSINA I

Male parameres without hairs (rarely with 1 or 2 adventitious hairs on one or both parameres) ....PAUSSINA II

Although I have seen most of the genera of paussids, there are still a few that I have not seen and others of which my material does not show the limits of variation. The following discussions of genera are therefore uneven, and are in some cases merely notes for the aid of future workers.

In the Protopaussini there is probably only one recognizable genus, *Protopaussus* Gestro. Kolbe (1924, 346, footnote) has tried to divide the genus on the form of the front tibia, which is weakly emarginate on the inner edge in most of the species but perhaps not in *feae* Gestro, but the supposed difference seems to be based on possibly inaccurate descriptions and figures rather than on comparison of specimens. Even if the difference exists, it may not be of generic value. In any case *Atavopaussus* Kolbe (*l. c.*) is a pure synonym of *Protopaussus,* for Kolbe inadvertently based his genus on *P. feae,* which was already the genotype of *Protopaussus. Abavopaussus* Kolbe (1927, 208 & 209) seems not to have been formally described. It is treated by Wasmann (1929a, 3) as an alternative spelling of *Atavopaussus,* but it seems likely that Kolbe, discovering that *Atavopaussus* was irrevocably a synonym, intended *Abavopaussus* (literally "forefather-paussus") to be a new genus for those *Protopaussus* with front tibia emarginate. He clearly uses the name in this way on page 208 (*op. cit.*), and it might well be so used if *Protopaussus* is divided. For an artificial key to the species of *Protopaussus* see Ribeiro 1930, 224.

In the Cerapterina I have seen five thoroughly distinct genera, and there are at least two additional existing genera which I have not seen. The following three keys suggest, but do not exhaust, the diversity of generic characters in this subtribe.

Non-genitalic Key to Existing Genera of Cerapterina, Excepting EOHOMOPTERUS

1. Second antennal segment reduced but still plainly visible; flagellar segments not wider than long (Fig. 47) (Australia) ....**Megalopaussus**

   Second antennal segment entirely sunken into the scape; flagellar segments wider than long 2

2. Front coxae low, usually separated by a narrow prosternal septum (Fig. 24); front tibiae emarginate on inner edge (Fig. 124) (Africa) **Carabidomemnus**

   Front coxae prominent, contiguous (Fig. 25); front tibiae not emarginate (except vaguely in some *Arthropterus,* Fig. 125) 3

3. Labium very small, acute (Fig. 104); (antennae and legs more or less expanded and flattened but not otherwise much modified) (Australian Region) ....**Arthropterus**

   Labium larger, acute or rounded (Fig. 105) (not Australian) 4

4. Tarsi very short, entirely retractile into the tibial apices (Fig. 132); labial palpi each with last two segments very widely dilated (Fig. 109) (America) ....**Homopterus**

   Tarsi longer, variable, but never entirely retractile; labial palpi not as above (Africa and Oriental Region) 5

5. Trichomes absent; antennal flagellar segments moderately to very widely (Fig. 49) expanded but not closely fitted together ....**Cerapterus**

   Basal prothoracic and basal elytral trichomes present (more or less hidden under basal edge of prothorax, Fig. 33); flagellar segments closely fitted together (Fig. 51) ....**Pleuropterus**

Key to Five Genera of Cerapterina Based on Male Copulatory Organs

1. Subapical orifice of middle lobe turned to left; (parameres rather broad; middle lobe with strong ventral process in species examined) (Figs. 146, 146½) ....**Carabidomemnus**

   Subapical orifice turned to right 2

2. Middle lobe wider, not narrowly cleft at apex 3

   Middle lobe more slender, narrowly cleft at apex 4

3. Apex of middle lobe plate-like with orifice trough-like; internal rod long; parameres more slender (Fig. 147) ....**Arthropterus**

   Apex of middle lobe not as described, but with a variable dorso-apical process; internal rod short; parameres very broad (Figs. 148–150) **Homopterus**

4. Differences undetermined (Figs. 151, 151½) ....**Cerapterus**

   Differences undetermined (Fig. 152) ....**Pleuropterus**

Key to Five Genera of Cerapterina Based on Female Styles

1. Styles obliquely truncate, the truncation bounded by an irregularly dentate ridge; setae rising from the truncation (Fig. 185) **Carabidomemnus**

   Styles not obliquely truncate 2
2. Styles palmately dentate; setae rising from between two large teeth near apex (Fig. 186) ....**Homopterus**

   Styles relatively simple at apex 3
3. Styles long, slender, without setae (Fig. 188) ....**Cerapterus**

   Styles shorter, with setae 4
4. Styles without differentiated apical portions; setae subapical (Fig. 187) **Arthropterus**

   Styles with differentiated, relatively slender apical portions; setae well before apex (Fig. 189) ....**Pleuropterus**

Cerapterine phylogeny has probably been complex. Existing genera are probably scattered survivors of a formerly larger and more diverse group. *Megalopaussus, Carabidomemnus,* and *Arthropterus* seem to be comparatively primitive but not necessarily closely related stocks; *Homopterus,* an isolated and (within the subtribe) derivative stock; *Cerapterus* and *Pleuropterus,* distinct members of a second derivative stock from another member of which the higher derivative paussids have probably come.

Megalopaussus is inadequately known. I have not seen it. Sloane (1933, 397) found no differences except in antennal structure between it and *Arthropterus,* but he may not have examined the front coxae or the mentum or the labium, and he certainly did not compare the male copulatory organs or female styles.

Carabidomemnus should include *Carabidobleptus* and probably also *Carabidodoxus* as subgenera, marked by a relatively small first flagellar segment and in some species by relatively slender legs. These forms have been discussed by Kolbe (1927a; 1928) and Wasmann (1928 with Pl. 6; 1929; 1929a). The male copulatory organs of *Carabidomemnus* (*s. s.*) *pallidus* (Fig. 146) and of *C.* (*Carabidobleptus*) *kirbyi* (Westw.) (Fig. 146½) are substantially similar. I have not seen *Carabidodoxus.*

Arthropterus is discussed in some detail by Sloane (1933), who describes the sad confusion of species in the genus, suggests the use of species-groups rather than subgenera, of which there are certainly too many named, and gives an incomplete classification of the species. The range of the genus is extended to New Guinea by Dohrn (1924).

Eohomopterus is not included in any of the preceding keys. It can be recognized by its unique tarsi, with segments 3 and 4 (or 2 and 3) enormously expanded (Fig. 135). Its antennae are of a simple cerapterine type. Its tibiae are rather slender, slightly widened apically, and the front tibiae are curved, broadly emarginate on the inner side (Fig. 126). However, its palpi, other mouth-parts, and other significant structures except those just mentioned are unknown. The genus is known from a single specimen (from Ecuador, now in the Oberthür Collection) which was described and figured (inadequately, by modern standards) as a species of *Homopterus* (Wasmann 1899, 33, Pl. 3, Figs. 1, 1a). The genus itself was named by Wasmann (1920, 110) without further examination of the specimen, and the latter seems not to have been seen by any of the specialists who have referred to it since then (Wasmann 1929, 59 . . . 74; Kolbe 1920, 137–139; 1927, 211; Reichensperger 1938a, 78, footnote; 1949; Jeannel 1946, 60). I see no use in guessing about the relationships of this genus to other Cerapterina. There is little real evidence that it is directly related either to the Australian *Arthropterus* (Kolbe 1920) or to the African *Carabidomemnus* (Jeannel 1946).

Homopterus should include *Arthropteropsis* as a subgenus, characterized by relatively simple antennae, with the flagellar segments not overlapping. There is no significant difference in mouth-parts, tibial and tarsal structure, or male copulatory organs. *Arthropteropsis praemonens* was originally described from eastern Bolivia, from one specimen. Reichensperger (1949) has recently discussed a second specimen, from Brazil; and I have examined a third, a ♂ from San Salvador (Central America), in the collection of the United States National Museum. Species of *Homopterus* (*s. s.*) are treated by Kolbe (1920), Darlington (1937; 1950), and Reichensperger (1938a).

Cerapterus should probably include *Mesarthropterus* as a subgenus, distinguished by relatively narrow antennae and legs (Reichensperger 1948, Pl. 1, Fig. 1). I have not seen *Mesar-*

thropterus, but Prof. Reichensperger has very kindly re-examined what is, I think, the only known specimen of it and writes that the front coxae are very prominent and contiguous, and that the labium is like that of *Cerapterus. Mesarthropterus* may eventually prove to be entitled to full generic standing, but none of its characters as now known seems to me to be of full generic value in a subtribe where other genera are so thoroughly distinct.

Pleuropterus needs no special discussion. The species of *Pleuropterus* and of *Cerapterus* (above) are chiefly African, and the African forms are listed with references by Reichensperger (1948). The Oriental species of *Cerapterus* are compared by Reichensperger (1935).

In the subtribe Pentaplatarthrina are only two genera: *Hyperpentarthrus,* with a relatively simple pronotum, and *Pentaplatarthrus,* with a complexly embossed one. I have not seen the former genus. It is figured by Reichensperger (1948, Pl. 1, Fig. 2). Wasmann (1920, 118–120) has keyed out the species of *Pentaplatarthrus* excepting *dollmanni,* which he described later (1922a, 141).

In the subtribe Platyrhopalina are at least four distinct genera, distinguished in the following key.

Key to the Genera of Platyrhopalina

1. Form very broad (Fig. 3); tibiae very wide; antennal flagellum evenly oval or circular, the first flagellar segment not set off by a notch posteriorly (Fig. 55); 4th tarsal segment not very small (Fig. 138) **Platyrhopalopsis**

   Form less broad; tibiae much more slender; flagellum variable but always either with conspicuous processes or with the first flagellar segment set off by a deep notch posteriorly; 4th tarsal segment very small (Fig. 137) 2

2. Prothorax only moderately expanded, not flattened at sides before the transverse suture; flagellum somewhat variable, sometimes irregular, but only rarely ("*Stenorhopalus*" Fig. 56) with more than one segment (the first) acutely produced or dentate (Figs. 53, 54) **Platyrhopalus**

   Prothorax widely expanded and more or less flattened at sides before the transverse suture; flagellum with several acute processes or teeth 3

3. Flagellum with segmentation at least in part more or less distinct, with 4 segments (not counting the first flagellar one) acutely produced or toothed posteriorly (Fig. 57); pygidial slits present (Fig. 42) **Lebioderus**

Flagellum with segmentation nearly obliterated, with only 2 or 3 segments (not counting the first flagellar one) acutely produced (Fig. 58); pygidial slits absent .... **Euplatyrhopalus**

Wasmann (1917, 392–393) has keyed out these genera (excepting *Lebioderus*) as subgenera of *Platyrhopalus,* and has added two more "subgenera" which are unknown to me. Whether his *Platyrhopalides* is a distinct genus or a subgenus or synonym of *Platyrhopalopsis* cannot be decided without specimens. Ribeiro (1930, 238) has overemphasized the importance of the slight difference in form of male copulatory organs (*cf.* his Figs. 11 & 12). The proper position of *Stenorhopalus* Wasmann (*op. cit.,* p. 390) is doubtful too. I place it as a subgenus of *Platyrhopalus* only provisionally. The genotype of *Stenorhopalus* (*tridens* Wasm.) is from Java and a second species is known from Fukien Prov., China (Wasmann 1922, 21). The Indian and Burmese species of this subtribe are of course treated by Fowler (1912) and Ribeiro (1930). Keys have been published to the species of *Lebioderus* by Heller (1926) and of *Euplatyrhopalus* by Wasmann (1910), and a species of the latter genus has been described from New Guinea by van Emden (1927). Jannsens (1948) has recently described a new *Platyrhopalus* (near *irregularis*) from Tonkin.

In the subtribe Ceratoderina are three easily distinguished genera, as follows.

Key to the Genera of Ceratoderina

1. Antennal flagellum with segments distinct, though of course soldered together (Figs. 59, 60) (Oriental Region) 2

Flagellum without traces of segmentation (Fig. 61); (prothorax with a transverse trichome-bearing cleft, with a small trichome-bearing tubercle on its anterior face on each side; maxillary palpi with 3rd segment swollen) (Africa) .... **Paussomorphus**

2. Prothorax with a transverse trichome-bearing cleft and with a small trichome-bearing tubercle before it on each side; maxillary palpi with 3rd segment wide, flattened .... **Merismoderus**

Prothorax with cleft reduced to a groove without trichomes, and without trichome-bearing tubercles; maxillary palpi with 3rd segment subcylindrical .... **Ceratoderus**

Although there are now no doubtful genera in the Ceratoderina, several species of "*Paussus*" which I have not seen may prove to belong there, and may necessitate a revision of generic characters.

Note the similarity in prothoracic trichome-pattern of *Paussomorphus* and *Merismoderus*. This first suggested to me a relationship which similarity of mouth-parts and genitalic characters, absence of tibial spurs, and absence of the ventral stridulatory organ amply prove.

Paussomorphus is still known definitely only from Abyssinia. *Merismoderus* is recorded from northern India (Fowler, Ribeiro), Sumatra (van de Poll 1890; Reichensperger 1935, 7), and Borneo (Reichensperger 1938, 101), and is to be expected in intermediate regions. *Ceratoderus* occurs in Ceylon, India, and Burma (Fowler, Ribeiro), Tonkin (Wasmann 1921, 161), and Java (Reichensperger 1935, 4–5), and probably in adjacent and intermediate places too.

In the two subtribes of Paussina, although there is extreme diversity of form and external adaptive structure, genera are very poorly defined. This is in contrast to the distinctness of genera in the other subtribes, and is consistent with a very recent evolution of the Paussina. Reichensperger (1930) has reviewed the not-very-successful efforts of earlier authors to divide the group, but, except that he separates *Hylotorus,* he still (1948) lumps all Paussina (I & II) in *Paussus,* without even subgenera. Jeannel (1946) recognizes a number of genera and subgenera, but I cannot agree with him in some of the characters and names that he uses. The names to use for groups of *Paussus* (*s. lat.*) is in itself a difficult problem. At least 35 such generic and subgeneric names (not including *Paussus* itself) have been suggested by Fowler (1912), Kolbe (1920, 1926, 1927, 1929, 1929a, 1933, 1935), Wasmann (1920, 1929), and Jeannel (1946), but many of the names are inadequately defined and without designated genotypes, and some of those published after 1930 are ***nomina nuda*** under the new rules of the International Commission of Zoölogical Nomenclature.

Ideally a classification of the Paussina should be worked out by synthesis, by examination of many species, definition of species-groups, and finally arrangement of the latter in subgenera and genera, but I do not have enough of the known species for this. The best I can do is to outline the apparent main pattern of evolution of the Paussina and suggest a few taxonomic consequences of it.

The two suggested subtribes, Paussina I and Paussina II, are tentative. All the species of each group can probably be recognized by a combination of external characters as well as by presence or absence of hairs on the male parameres. The principal distinguishing characters of the two groups are listed in Table 4.

TABLE 4. *Characteristics of Paussina I and Paussina II*

Paussina I	*Paussina II*
Antennal flagellum with not more than 5 segments, usually more or less lens-shaped, often with basal trichome, without posterior excavation, usually without teeth or processes.	Antennal flagellum often with more than 5 segments, variable in form but rarely lens-shaped, usually without basal trichome, often with posterior excavation or vestige of it, often with teeth or processes.
Head with 1 frontal opening (if any) often at the apex of a frontal horn; eyes usually large, prominent, with sides of head behind them simply rounded.	Head usually with 2 frontal openings (if any) (but the 2 openings merge on a frontal horn in some Malayan forms); eyes usually small, less prominent, more enclosed behind by sides of head.
Prothoracic cleft usually simple, often reduced to a groove or suture without trichomes; sides of prothorax usually not prominent before the cleft (Fig. 35).	Prothoracic cleft usually deep and complex, rarely (only in *Hylotorus*?) reduced to a groove or suture without trichomes; sides of prothorax usually angulately prominent before the cleft (Figs. 36, 37).
Tibial spurs present.	Tibial spurs usually absent (but present in *Paussus laetus*)
Male parameres both tipped with several hairs.	Male parameres without hairs, or rarely with 1 or 2 hairs on one or both parameres.

It should be emphasized that most of the characters listed in Table 4 are marred by exceptions, and it is not clear how many of the latter are parallelisms and how many represent a real breakdown of genetic lines. If it proves that the two suggested subtribes cannot be maintained, the Roman numerals can be dropped and the two groups merged as one subtribe, the Paussina, well defined by possession of the stridulatory organ and by both male and female genitalic characters.

Of the species I have seen, *Paussus donisthorpei* is nearest to intermediate between the two subtribes. It has indications of two frontal openings, the eyes are rather small, the prothorax is like that of *Paussus* but with sides less prominent anteriorly than usual, tibial spurs are absent, and the male parameres are glabrous or tipped with only one or two hairs. In these ways *donisthorpei* agrees better with the Paussina II than with the Paussina I. The antennae have only 5 segments clearly indicated in the flagellum, and on this character the species might go in either subtribe. But the flagellum (Fig. 83), while not quite like that of any Paussina I known to me, is vaguely lens-shaped, lacks any trace of a posterior sulcus, and has a small basal trichome-clump under the posterior basal angle. The apex of the middle lobe of the male copulatory organ of this species (Fig. 168) is like that of *Edaphopaussus,* although not much different from some *Paussus* too. I suspect that this species, although more of a *Paussus* than of an *Edaphopaussus,* is in some ways near the ancestral stock of the latter. Similarly, *Paussus laetus,* which still has tibial spurs, may retain this character from the common stock of both subtribes of Paussina.

In the Paussina I there is perhaps only one main genus (*Edaphopaussus*) and one derived one (*Bathypaussus*), but the species of the main genus can and should be arranged in species-groups characterized by form of antennal flagellum, presence or absence of frontal horn and opening, state of prothoracic cleft and presence or absence of trichomes in it, presence or absence of pygidial trichomes and margin, and other details. There seems to be little variation in this subtribe in form of apex of the middle lobe of the male genitalia (which I have examined in a number of species, although I have figured only three), a fact which suggests recent evolution and dispersal. The species of *Edaphopaussus* are most diverse in Africa, much less so in India and Burma (usually hornless and apparently always with prothoracic cleft reduced and without trichomes), apparently absent in the Malay region, and absent in Madagascar. *Bathypaussus* consists of a few species in Africa and one in Madagascar. The genotype of *Edaphopaussus* is unfortunately *Paussus americanus* Kolbe, which I have not seen. It was at first thought to be South American but later proved to be

African. Reichensperger (1948, 21) gives references covering the taxonomic history of the species. It is related to *E. goetzei* (Kolbe, 1926, 172–173) (my Fig. 69). The application of the name *Bathypaussus* is discussed below.

The Paussina II is a larger and much more diverse group. Most of its members are apparently derived from an original stock with a 9-segmented, excavated antennal flagellum which seems to have been modified independently in several main and many minor lines (*cf.* p. 62), and there has been much evolution and some atrophy of minor glandular structures and much minor modification of mouth-parts, legs, etc. in different lines. The main lines seem in part to be geographically isolated.

In Africa there may be several main lines of Paussina II. At least there are several African species-groups of which I cannot trace the relationships in detail. They vary in external adaptive structure, and they vary also somewhat more than the Paussina II of other regions in form of apex of the male middle lobe. One extreme African group is usually ranked as a full genus, *Hylotorus* (Fig. 6), although about the only characters defining it are subcylindrical form and resultant modifications of legs, antennae, etc. The extreme species of *Hylotorus* are connected with more normal Paussina II by intermediates (*cf.* Reichensperger 1930) which include less evolved species of *Hylotorus* and a group incorrectly called *"Bathypaussus"*. *"Bathypaussus"* illustrates the confusion of names in the Paussina. It was proposed by Wasmann (1929a, 24) for *Paussus cultratus* Westw., *granulatus* Westw., and *aldrovandii* Gestro. Reichensperger (1930) showed that *cultratus* and *aldrovandii* are not related to *granulatus* (they are in fact members of Paussina I) and in effect restricted *Bathypaussus* to *granulatus* and a new species, but he did not formally fix a genotype. Kolbe (1933), ignoring *Bathypaussus*, published new subgeneric names apparently intended for both *cultratus* and *granulatus*, but his names are *nomina nuda* under existing rules of nomenclature. Jeannel (1946), ignoring Reichensperger's informal restriction, and not understanding that two different stocks were involved, has taken *aldrovandii* as the genotype of *Bathypaussus*. By so doing he has fixed the name in the Paussina I and made it unavailable for relatives of *Hylotorus*. It seems convenient to treat as full genera both *Hylotorus* and the related forms just discussed. For the latter I propose the name **Falcopaussus** gen. nov.; genotype, *Paussus granulatus* Westw.; distinguished from most other Paussina II (*Paussus* etc.) by simply falcate antennal flagellum (Fig. 84), and characterized also by a very deep prothoracic cleft. The genus is more accurately defined in the key (below).

In Madagascar, excepting the one *Bathypaussus* (Paussina I), all known paussids, 30-odd species, may belong to one line of Paussina II, derived from one ancestor. I have already discussed the modifications of the antennae (p. 62) and legs (p. 70) in this line. The existence of an independent Madagascan line is supported by the form of the middle lobe of the male copulatory organ. I have been able to examine it in only a few of the species, but it is nearly the same in the most primitive (*e. g. Paussus scyphus,* Fig. 173) and most derivative (*Anapaussus,* Fig. 175) members of the line, with the apex of the middle lobe more nearly (obliquely) subtruncate than usual in African or Oriental *Paussus.* An extreme species-group with very long legs, curious antennae, and no dense pygidial trichome-fringe is probably worth generic recognition under the name *Anapaussus* (Fig. 5). Other species-groups are distinguishable but are not worth naming now. Whether *Enneapaussus howa* belongs to the Madagascan line or has had a separate origin from an African *Paussus* is not clear. Jeannel (1946) puts this genus in a tribe of its own and associates it with the cerapterines, but this is a mistake—a result of classifying paussids almost entirely on superficial antennal structure. The genus has all the basic characters of *Paussus:* the same mouth-parts, prothoracic cleft, stridulatory organ, wing-venation, male and female genitalia, etc. It is in fact barely distinguishable from *Paussus,* and the only question is whether it is more closely related to African or Madagascan species. It resembles the Madagascan species of *Paussus* in shape of apex of male middle lobe, and differs from them apparently only in details of form and appearance, lack of a dense pygidial trichome-fringe, and by having traces of 9 segments still visible in the flagellum.

In the Oriental Region the lines of Paussina II are less complex than in Africa but more so than in Madagascar. There may be only one main Oriental line. I cannot differentiate it sharply from

African lines, but its existence is suggested by the form of the male middle lobe, which is usually less arcuate in Oriental than in African forms, with the apex less variable. The segmentation of the flagellum is reduced in some cases, but vestiges of it usually remain (in Oriental species) as processes or impressions. The excavation of the flagellum is partly or completely closed in several different Oriental forms, but a vestige of it usually remains as an impression or suture or slight ridge. The Oriental Paussina II include several species-groups characteristic of southern Asia and others characteristic of the Malayan Subregion, but none seems worthy of generic standing now.

My conclusions about genera of Paussina are restated in the following key, which is provisional and by no means a fully satisfactory or final treatment of the group.

Provisional Key to the Genera of Paussina I & II (Paussids with Ventral Stridulatory Apparatus)

1. Parameres of male copulatory organ each with several hairs at apex; tibial spurs present; (for additional characters see Table 4) (Paussina I) 2

   Parameres without hairs, or rarely with 1 or 2 hairs; tibial spurs usually absent (but present in *Paussus laetus* and perhaps in other species which I have not seen) (Paussina II) 3

2. Antennal flagellum not sickle-shaped (Figs. 62–71); (to be further divided into genera and/or species groups) ....**Edaphopaussus**

   Flagellum strikingly sickle-shaped (Figs. 72–73) ....**Bathypaussus**

3. African forms; middle lobe of male copulatory organ usually strongly arcuate, with apex variable but usually not subtruncate (Figs. 164–171) 4

   Oriental or Madagascan forms; male middle lobe usually either less arcuate or with apex more nearly (obliquely) subtruncate 5

4. Antennae variable (Figs. 74–83) but not as described in following half of couplet; (to be further divided into genera and/or species-groups) African stocks of **Paussus**

   Antennal flagellum strikingly sickle-shaped or short, oval, flat, and retractile against front of head before eyes 8

5. Oriental forms; male middle lobe usually less arcuate, with apex not subtruncate (Figs. 177–184); (to be further divided into genera and/or species-groups) ....Oriental stock(s) of **Paussus**

   Madagascan forms; male middle lobe more arcuate, with apex more nearly (obliquely) subtruncate (Figs. 172–175) 6

6. Pygidium with dense marginal trichome-fringe (in Madagascan species); antennal flagellum with or without traces of segmentation, but never (in Madagascan species) with more than 8 flagellar segments indicated (Figs. 89–91); (to be further divided into genera and/or species groups) .... Madagascan stock(s) of **Paussus**

   Pygidial trichomes, if present, not forming a dense marginal fringe 7

7. Legs and antennae not very elongate; flagellum with 9 plainly distinguishable segments (Fig. 88) .... **Enneapaussus**

   Legs and antennae very elongate (Fig. 5); flagellum not distinctly segmented, usually distorted or with irregular processes, but sometimes simple (Figs. 92–94) .... **Anapaussus**

8. Flagellum sickle-shaped (Fig. 84); form not cylindrical .. **Falcopaussus**

   Flagellum either sickle-shaped or short and retractile (Figs. 85–87); form subcylindrical or cylindrical (Fig. 6) .... **Hylotorus**

See the general references given below (Reichensperger, Fowler, Ribeiro) for the African and Indian species of the subtribes of *Paussina* (but *Edaphopaussus,* etc. are not distinguished from *Paussus* in these works); and see Jeannel (1946) for the Madagascan forms (but his arrangement of genera and subgenera is unacceptable in many details). See also Wasmann (1904, 67–71; 1928a, 242) for keys to some Malayan species of *Paussus.* However, these references are only an introduction to the Paussina of the different regions. For example, to work on those of the Oriental Region it is necessary to compile a complete catalogue and bibliography of them from the older lists, the *Zoölogical Record,* and other sources.

What I have said about paussid classification is summarized in the following systematic list of genera and higher categories. The list includes some additional information on genotypes, numbers of species, and distributions. A list of paussid genera, with number of species of each, is given by Reichensperger (1948, 10). My figures have been derived independently, not copied from him. Richensperger (*op. cit.,* with mimeographed correction sheet issued October 1949 covering *Paussus cridae* to *damarinus*) lists the known African and Madagascan species of paussids, with references and synonymy. Jeannel (1946) has covered the Madagascan species; Fowler (1912) and Ribeiro (1930), those of "British India". Additional references to treatments of species are given for some groups in the preceding discussions. Earlier work on paussids is summarized in *Genera Insectorum* (Desneux 1905) and the Junk-Schenkling *Coleopterorum Catalogus* (Gestro 1910), and later work is listed annually in the *Zoölogical Record.*

TABLE 5. *Systematic List of Existing Genera and Higher Groups of Paussids*

PRIMITIVE PAUSSIDS

Tribe Protopaussini

Protopaussus Gestro (syns. *Atavopaussus* Kolbe, *?Abavopaussus* Kolbe). Genotype: *P. feae* Gestro. Species: 5. Oriental Region (India and southern China to Java and Luzon).

Tribe Paussini

Subtribe Cerapterina

Megalopaussus Lea. Genotype: *M. amplipennis* Lea. Species: 1. Australia (North Queensland).

Carabidomemnus Kolbe (subgen. *Carabidodoxus* Kolbe, *Carabidobleptus* Kolbe). Genotype: *Arthropterus pallidus* Raffray (present designation). Species: 13. Africa below the Sahara.

Arthropterus MacLeay (many syns. or subgen.). Genotype: *Cerapterus macleayi* Donovan. Species: perhaps 40-odd (84 described, but many are synonyms). Australia (perhaps 40-odd species) and New Guinea (1).

Eohomopterus Wasmann. Genotype: *Homopterus aequatoriensis* Wasmann. Species: 1. South America (Ecuador)

Homopterus Westwood (syn. *Neopaussus* Thomson; subgen. *Arthropteropsis* Kolbe). Genotype: *H. brasiliensis* Westwood. Species: 10. Tropical America (Bolivia and Brazil to San Salvador and British Honduras).

Cerapterus Swederus (sev. syns. and/or subgen., including ?subgen. *Mesarthropterus* Wasmann). Genotype: *C. latipes* Swederus. Species: 30. Africa below the Sahara (25 species) and the Oriental Region (5, Ceylon and India to Java and Mindanao).

Pleuropterus Westwood (sev. syns. and/or subgen.). Genotype: *P. westermanni* Westwood. Species: 20. Africa below the Sahara (17 species) and the Oriental Region (3, Ceylon and India to Java).

Subtribe Pentaplatarthrina

Hyperpentarthrus Kolbe. Genotype: *Pentaplatarthrus schoutedeni* Reichensperger. Species: 1. West Africa.

Pentaplatarthrus Westwood. Genotype: *P. paussoides* Westwood. Species: 7. East and South Africa.

DERIVATIVE PAUSSIDS

Subtribe Platyrhopalina

Platyrhopalus Westwood (?subgen. *Stenorhopalus* Wasmann). Genotype: *Paussus denticornis* Donovan. Species: 15. Oriental Region

(India and southern China to Java). Reichensperger (1948, 10) has shown that the old African record for this genus was an error.

Lebioderus Westwood. Genotype: *L. goryi* Westwood. Species: 7. Malayan Subregion of the Oriental Region (Sumatra, Java, Borneo, Luzon).

Euplatyrhopalus Desneux. Genotype: *Platyrhopalus aplustrifer* Westwood (present designation). Species: 5. Oriental Region (4, India to Java) and New Guinea (1).

Platyrhopalopsis Desneux (?syn. or subgen. *Platyrhopalides* Wasmann). Genotype: *Platyrhopalus mellyi* Westwood (present designation). Species 3. Oriental Region (continental part only).

Subtribe Ceratoderina

Merismoderus Westwood (syns.). Genotype: *M. bensoni* Westwood. Species: 3. Oriental Region (India, Sumatra, Borneo).

Ceratoderus Westwood. Genotype: *Paussus bifasciatus* Kollar. Species: 6. Oriental Region (Ceylon and India to Java).

Paussomorphus Raffray. Genotype: *Paussus chevrolati* Westwood. Species: 1. Africa (Abyssinia).

Subtribe Paussina I

Edaphopaussus Kolbe (sev. syns. or subgen.). Genotype: *Paussus americanus* Kolbe (an African species). Species: numerous. Africa (numerous) to southern France (1), and Oriental Region (numerous, Ceylon, India, and Burma, but apparently not the Malayan Subregion).

Bathypaussus Wasmann. Genotype: *Paussus aldrovandii* Gestro. Species: few. Africa below the Sahara (few) and Madagascar (1).

Subtribe Paussina II

Paussus Linné (many syns.; species-groups, subgenera, and additional derived genera to be worked out). Genotype: *P. microcephalus* Linné. Species: very numerous. Africa (numerous), Madagascar (30, not counting derived genera), Asia Minor to Greece (1), the entire Oriental Region (numerous, Ceylon, India, and southern China to Java, Borneo, Philippines). Probably distinct African, Madagascan, and Oriental lines, and several derived genera (below).

Enneapaussus Jeannel. Genotype: *Paussus howa* Dohrn. Species 1. Madagascar.

Anapaussus Wasmann. Genotype: *Paussus dama* Dohrn. Species: 5. Madagascar.

Falcopaussus Darlington. Genotype: *Paussus granulatus* Westwood. Species: few. Africa below the Sahara.

Hylotorus Dalman. Genotype: *Paussus bucephalus* Gyllenhal. Species 7. Africa below the Sahara.

The taxonomic innovations suggested in this paper, and included in Table 5, are not easy to summarize. Interested persons should compare my classification with preceding ones (Desneux 1905; Gestro 1910; Jeannel 1946; Reichensperger 1948; etc.), which differ greatly among themselves. Generally speaking, my use of higher categories is mostly new; of genera, mostly conventional. The informal distinction between "primitive" and "derivative" paussids is new. The tribal name Paussini is used in a new sense. All the subtribal names are new and several of them are applied to groups which have not been recognized or at least not defined before under any names. I have used a few generic and subgeneric names differently from either Jeannel or Reichensperger. In some cases I have returned to earlier usage, but the placings of *Arthropteropsis* as a subgenus of *Homopterus, Mesarthropterus* as a subgenus of *Cerapterus,* and *Platyrhopalides* as a synonym or subgenus of *Platyrhopalopsis* are new. *Falcopaussus* is proposed as a new generic name, and genotypes are designated for *Carabidomemnus, Euplatyrhopalus,* and *Platyrhopalopsis.*

ZOÖGEOGRAPHY OF PAUSSIDS

The geographical distribution of paussids has been touched on by several authors, not always with fortunate results.

Kolbe (1920) thought that the South American cerapterines were related to Australian *Arthropterus* and derived from it across an Antarctic land bridge; but the supposed direct relationship probably does not exist. Kolbe (*op. cit.*) thought too that he had a South American *Paussus* derived from an Australian one across the same Antarctic bridge. This was one of the most complete errors ever made by a zoögeographer. The two species turned out not to be related, and both had wrong locality labels; they belonged to different genera, and both were really African (*Paussus* does not occur in Australia or America). As Wasmann (1929, 14–15, footnote 2) said, *"Die Hypothese seiner Einwanderung ist damit erledigt."*

Jeannel (1942, 250; 1946, 60 & 95) interprets paussid distribution in terms of pre-Jurassic age and continental drift; but the paussids are probably not that old; no direct relationships such as would be expected to result from continental drift have been demonstrated between the paussids of Africa, South America, and Australia; and the continental-drift theory ignores the cerapterines in the Baltic amber, and runs into difficulties in other ways. For example, it fails to explain the absence of primitive paussids in Madagascar.

The actual present distribution of paussids is shown on the maps (Maps 1–3) at the end of this paper. The maps are designed to show main patterns of distribution rather than details. The latter have been shown accurately where possible, but paussid distribution is not yet known in full detail.

Paussids are primarily tropical. Most of the species occur within the tropics, and the distribution of the group as a whole is almost exactly balanced on the tropical zone (Map 1). Some paussids enter the warm edges of the temperate zones, but there is no true temperate paussid fauna. *Edaphopaussus favieri,* which reaches the southwestern corner of France (Jeannel 1941, 92), is probably the northernmost existing paussid, but it is still seven or eight hundred miles south of the latitude of the Baltic amber, and it is a single outlying species, whereas a whole fauna of primitive paussids existed in the Baltic region when the amber was formed. The subtribe Cerapterina, which is so well represented in the amber, does not now occur within about two thousand miles of the Baltic region (Map 2). *Paussus turcicus* ranges north to Greece. A few paussids reach southern China, but I do not know their exact northern limits there. Fowler's statement (1912, 469), cited from Wasmann, that *Platyrhopalopsis picteti* (Westw.) is widely distributed in northern China, is an error; Wasmann (1904, 18–19) really said northern India. Southward, in the Old World, paussids reach South Africa and southern Australia, but apparently not Tasmania. Species of *Arthropterus* are numerous in temperate Australia, but the genus occurs also in the tropical parts of the Australian Region. It is apparently geographically isolated rather than specially adapted to temperate climate. In America, where paussids are few and rare, they seem to be confined to the tropics, from British Honduras to Bolivia.

The absence of paussids from cold places may be due to an intolerance for cold perhaps inherited from the Ozaenini, which are chiefly tropical too. Or the absence of paussids at least from the north-temperate zone may be due partly to their association with ants, which complicates their lives. Other complex biological associations, for example those involving "mimicry", tend to be developed best in the tropics, least in the cool, unstable north. It should be noted, however, that the higher groups of paussids do not seem to be directly restricted in their distribution by dependence on localized groups of ants. They are probably not so strictly host-specific, and they do not follow their ant hosts to the limits of the latters' distributions. For example, many derivative paussids occur with the ant genus *Pheidole,* but the derivative paussids are confined to the Old World and do not even reach Australia, while *Pheidole* is cosmopolitan.

Paussids are not well represented on islands. At least two stocks of Paussina have reached Madagascar, and one of them has radiated on the island. One Madagascan species is recorded also from Réunion (Jeannel 1946, 62–64), but may not be native there. Otherwise, none is known from the Mascarene Islands or the Seychelles. Various paussids occur on the continental islands of Ceylon and Formosa and on the Indo-Australian Archipelago, at least on most of the larger islands including the Philippines and New Guinea. None has yet been found on Celebes or the Moluccas, but some probably occur there. None is known from the Solomons or the more remote Pacific islands. In the New World none is known from the West Indies or the Galapagos. The Ozaenini, although as a group they are much fewer in species than the paussids, are relatively somewhat better represented on islands: they occur on all of the islands just mentioned as inhabited by paussids except perhaps Ceylon and except Réunion, if there is a paussid there; *Pseudozaena* reaches the Solomons and also the Palau Islands, but may be introduced on the latter; and different stocks of *Pachyteles* have reached Cuba, Jamaica, and the Lesser Antilles in the West Indies. The slightly wider distribution on islands of Ozaenini as compared with paussids is not due to greater age, for the island ozaenines are not ancient but are slight modifications of existing mainland stocks. That they rather than paussids have reached certain islands may be chance, or may be due to their simpler way of life. Dependence on ants may make it difficult for paussids to establish themselves across water barriers or to exist in small areas.

Within the limits described above, the seven tribes and subtribes of paussids are very differently distributed (Maps 2 & 3).

The Protopaussini, with one genus and a few, rare species, are confined to the Oriental Region.

The Cerapterina, with at least seven full genera and a moderate number of species, are almost tropicopolitan, but are absent on Madagascar (see p. 103 for comment on Jeannel's idea that *Enneapaussus* represents the "Cerapteritae" on Madagascar). They are the only paussids in Australia (where, as also in Africa, they enter the south-temperate zone) and in America, and the only ones in the Baltic amber, except distinct *Eopaussus*. The highly evolved cerapterine genera *Cerapterus* and *Pleuropterus* are common to Africa and the Oriental Region. How the other cerapterines of different continents are related among themselves has not been determined. Most of them are probably not directly related at all, but are isolated survivors of a formerly larger and more diverse group.

The Pentaplatarthrina, with two genera and few species, inhabit most of Africa below the Sahara, but not Madagascar.

The Platyrhopalina, with four genera and a moderate number of species, occur throughout the Oriental Region, and one outlying species is on New Guinea. (A supposed African species proved to be wrongly assigned.)

The Ceratoderina have one monotypic genus isolated in Abyssinia in Africa; and two other genera, with few species, are widely distributed in the Oriental Region.

Of Paussina I, *Edaphopaussus* has many species in Africa (one reaching Spain and the southwestern corner of France) and some through India at least to Burma; and *Bathypaussus* has a few species in Africa and one in Madagascar.

Of Paussina II, *Paussus* has many species in Africa and Madagascar, a few in southwestern Asia (one reaching Greece), and many through the Oriental Region; and there are also two derived genera, with few species, in Africa, and two more in Madagascar.

The main pattern of paussid distribution fits reasonably well the pattern of conventional faunal regions (Table 6), with a Madagascan Region added. The classification of the regions as "Climate-limited", "Main", and "Barrier-limited" is one which I have used in teaching but which has not been published before.

TABLE 6. *Distribution of Paussids by Conventional Faunal Regions*

Climate-limited regions

Palearctic Region: a few Paussina I & II in southern edge, and probably a few other paussids in southern temperate China
Nearctic Region: no paussids

Main regions

Ethiopian Region: Cerapterina (primitive and advanced genera)
    Pentaplatarthrina
    Ceratoderina (one localized form)
    Paussina I
    Paussina II
    (No Protopaussini, no Platyrhopalina)
Oriental Region: Protopaussini
    Cerapterina (advanced genera only)
    Platyrhopalina
    Ceratoderina
    Paussina I
    Paussina II
    (No especially primitive genera of Cerapterina, no Pentaplatarthrina)

Barrier-limited regions

Neotropical Region: Cerapterina only
Australian Region: Cerapterina
    Platyrhopalina (one species, in New Guinea)
[Madagascar: Paussina I & II only]

To complete this summary of the main pattern of distribution of paussids it should be added that, in the main regions, derivative paussid species outnumber primitive ones by nearly 4 to 1, the exact ratio being a little lower in Africa, higher in the Oriental Region (Table 7).

TABLE 7. *Numbers of Species of Primitive and Derivative Paussids Known from Africa (Without Madagascar) and the Oriental Region*

	Africa		*Oriental Region*	
Primitive paussids				
Protopaussini	0		5	
Cerapterina	55		8	
Pentaplatarthrina	8		0	
		63		13
Derivative paussids				
Playtyrhopalina	0		29	
Ceratoderina	1		9	
Paussina I & II	185		70	
		186		108

The main pattern of paussid distribution as shown by the maps and Tables 6 and 7 is this. All the main groups of both primitive and derivative paussids occur in Africa and/or the Oriental Region, chiefly in the tropics. The primitive subtribe Cerapterina occurs also in Australia and in tropical America, and is fossil in the Baltic amber. And a few of the derivative groups extend from the main regions into the edge of the Old-World north-temperate zone, to Madagascar, and in one case to New Guinea.

This is a simple and clearly cut geographical pattern. The probable explanation of it is simple too, at least in its main features. The paussids have evolved chiefly in the great land areas of the Old-World tropics. The first dominant group, the primitive Cerapterina, spread from there over most of the world except Madagascar, then withdrew from northern areas into its present discontinuous but nearly tropicopolitan range. And existing derivative paussids arose later, became more numerous than the primitive forms in the main regions, and spread over as much of the rest of the world as was then suitable and as they could reach, but only a few of them have been able to reach even a little beyond the main tropical regions of the Old World. This simple history, involving much more evolution and expansion than recession and extinction (although there must have been some of the latter), is the sort to be expected of a relatively recent, rapidly evolving group of animals.

In more detail, the apparent history of the paussids is this.

Paussids probably originated late in the Cretaceous (see p. 87). Their place of origin was probably somewhere in the main regions of the Old-World tropics. Perhaps (but this is sheer guess-work) it was in what is now the Oriental Region. The very primitive Protopaussini are confined to the Orient, and from there the early Cerapterina might have been most likely to reach Australia and America without reaching Madagascar. Some existing African and Australian cerapterines are more primitive than any existing Oriental ones, but this may be due to extinction in the Orient rather than to an African or Australian origin. Great differences in genitalic and other characters make it seem unlikely that the African and Australian forms are directly related—and primitive cerapterines occur in the Baltic amber too.

At the end of the Cretaceous several groups of primitive paussids (Protopaussini, Cerapterina, perhaps Eopaussina) may have been in existence, but the cerapterines were probably dominant. Whatever their exact place of origin, they probably spread through the whole of the Old-World tropics, perhaps to Australia (but this may have been later), north through what is now temperate Eurasia, and into America probably over a Bering land bridge. This bridge (or succession of bridges) across Bering Strait has been the principal or only one between the Old and New Worlds since the beginning of the Tertiary, according to Simpson's (1947) recent, thorough analysis of the evidence of fossil mammals, and many more animals crossed it at the beginning of the Tertiary, when the climate was apparently relatively warm, than did so later. The cerapterine paussids probably spread through North America into South America not later than the beginning of the Tertiary, for we know, again principally from the evidence of fossil mammals (Simpson 1940), that South America became isolated from the other continents at about that time, and remained isolated until late in the Pliocene. The American cerapterines are different in many ways from existing Old-World forms. Their distinctness is consistent with a relatively early isolation. Of course the cerapterines may have reached South America by some route other than through North America, if another one existed, but the North American route seems perfectly possible for them.

At the end of the Eocene or early in the Oligocene cerapterines were still the dominant paussids. The Baltic amber shows this fact and suggests that the cerapterines still occurred far enough north to have had a chance to reach America across the Bering bridge. But if they did so at this time, they were probably barred from South America, which had been isolated, and later they died out in North America, as did the earlier cerapterine stocks. Eventually the cerapterines disappeared not only in North America but in the north-temperate zone of the Old World too, and survived only in the warmer, discontinuous areas they now inhabit. The known fact, attested by the Baltic amber, that cerapterines once occurred in northern Europe and have disappeared there, makes their former presence in, and disappearance from, the whole north-temperate zone more easy to accept.

At some time during the Tertiary the Pentaplatarthrina were derived from a cerapterine ancestor probably in Africa, where they have remained.

Probably during the middle and late Tertiary, the derivative paussid subtribes evolved somewhere in the main regions of the Old-World tropics. To fix their places of origin more exactly is difficult, but there are indications that the chief center of evolution of the derivative groups may have been Africa, that successive groups may have dispersed from Africa to the Oriental Region, and that the earliest derivative groups may have died out in Africa perhaps as a result of the rise of later groups.

The first derivative subtribe, the Platyrhopalina, is now confined to the Oriental Region (and New Guinea). There is no direct evidence that it has ever been in Africa. But all existing members of the subtribe have lost the trichome-bearing prothoracic cleft. This suggests extinction of a whole ancestral stock of cleft- and trichome-bearing forms, which might have been African. If this idea seems far-fetched, remember that in the Paussina I, of rather diverse African forms, only those in which the prothoracic cleft and trichomes have atrophied have reached the Orient. Whatever the origin of the Platyrhopalina, the differentiation of the endemic Malayan genus *Lebioderus* and the presence of a species of *Eu-*

platyrhopalus in New Guinea suggest that the subtribe has been in the Oriental Region a relatively long time.

The subtribe Ceratoderina fits more obviously into the suggested dispersal pattern. The single known African form is geographically localized and flightless, and may well be a relict, while the Oriental forms are more numerous and much more widely distributed. This could be a late stage in dispersal of a group which originated in Africa, spread to the Orient, and is now disappearing in Africa.

The subtribe Paussina II precedes the Paussina I in pattern of distribution. The Paussina II are now dominant in both Africa and the Oriental Region, but they are structurally more diversified in Africa, as if they have originated and differentiated there, then sent a limited number of stocks into the Orient.

The subtribe Paussina I is dominant in Africa, where it rivals the Paussina II in number of species but not in diversity of structure. Of the African forms, some have well-developed prothoracic clefts, some vestigial ones. The subtribe has reached the Oriental Region, but only its nearer part (not the Malayan Subregion), and the Oriental species are less diverse than the African ones, with the prothoracic cleft probably always vestigial.

The diagram (Fig. 207) which precedes the maps shows how the four subtribes of derivative paussids fall into the common hypothetical pattern, of origin in Africa, dispersal to the Oriental Region, and (in the earlier subtribes) extinction in Africa.

The paussids of Madagascar are something of a problem. Jeannel (1946, 95–96) supposes that five separate paussid stocks have reached the island, four from Africa, the fifth from India. The supposed Indian stock (subgenus *Scaphipaussus* of *Paussus*) he thinks reached Madagascar over a Lemurian land bridge. However, I see no real relationship between the Indian and Madagascan forms; no paussids have been found on the intermediate Seychelles; and the Lemurian bridge, if it existed at all, probably disappeared long before the origin of the paussids in question. I think it likely (but not certain) that all Madagascan paussids are in fact derived from two ancestors which reached Madagascar from Africa at different times, across the water gap. The first was a species of *Paussus* (Paussina II) from which may have been derived the 36 known species, in 3 genera, which make up the whole Madagascan paussid fauna except for the following species. The second was a species of *Bathypaussus* (Paussina I) which probably arrived much later and which is still not very different from its African relatives. The greatest problem is not how these derivative paussids reached Madagascar but why older, primitive ones did not do so too. Possibly they did, and later became extinct. Or more likely they were stopped by the water barrier which the two derivative forms eventually chanced to cross.

The one derivative paussid in New Guinea, a *Euplatyrhopalus* (Platyrhopalina), probably reached that island across at least narrow water barriers, for New Guinea has probably not been connected with Asia by continuous land since the origin of the derivative paussids.

This history of paussid dispersal is hypothetical. Nevertheless I give it a high degree of probability in its main points. It accounts for all the important, pertinent facts. It is correlated with known geological events such as the Tertiary isolation of South America and the existence of a former Bering land connection. It follows a general pattern set by other cold-blooded animals (*cf.* Darlington 1948). And the history itself is supported by much indirect and some direct evidence, most dramatically by the Baltic amber, which shows not only that cerapterine paussids once occurred far enough north to have had a chance to cross a northern land bridge, but also that great changes have occurred in the composition and distribution of paussid faunas since about the beginning of the Oligocene. But, of course, the actual history of paussids must have been infinitely more complex in detail than I have made it, and some of the details given may be wrong.

POSTSCRIPT

In this paper I have tried to do a little more than just to describe the structure and relationships of paussids and to set up a partly new classification of them. I have tried to show, in a somewhat disjointed way and in necessarily technical language, how a primitive carabid beetle entered an ants' nest somewhere in the tropics of Asia or Africa perhaps seventy or eighty million years ago, how its descendants evolved and became adapted to life with ants, how they diversified, how different lines diverged or ran parallel in both evolution and atrophy of different organs, and how the different main lines spread over the world or parts of it. To write this paper has been for me an exciting experience, with no precedent in any of the purely taxonomic work that I have done. I say this knowing well enough that what I have written is no more than an imperfect introduction to the paussids, that far more remains to be done than has yet been done or than can be done now. Even the mechanical work of collecting, describing, and classifying existing forms is still very far from complete, and that is just the beginning. Almost all that has been written about paussids has been about dead adults. The ecology of the living beetles and their behavior with reference to ants have been guessed at but rarely observed. The evolution of behavior patterns, and the relation of structure to function in the paussids are even less known subjects. I have made some guesses about the function of the strikingly modified antennae and mouth-parts, but the guesses are based on interpretation of structure rather than on study of function itself. About some other details we can as yet hardly even guess. We do not know (at least I do not) why paussids have become, apparently, relatively non-tactile insects. I should have supposed the tactile sense would be very useful to myrmecophiles. We do not yet know whether paussids really have abnormal sex-ratios, or why an excess of males seems to be correlated with certain physical characteristics of the insects. We do not know when or why some paussids stridulate, whether it is a private affair or has something to do with ants. In fact, so far as I can find, no one has even noticed the stridulatory apparatus before, although more than half the known species of paussids have it. And little as we know about the adults we know still less about the larvae. Only four species of paussid larvae have been recorded. These examples suggest how deep is our ignorance of the lives of paussids. But I hope I have said enough to prove at least that they are fascinating insects, that their study is perhaps fruitful now but potentially much more so. We know within very narrow limits what the ancestor of the paussids was like. We know beyond doubt the main directions of their evolution. The changes that have occurred during their evolution have been striking and are almost wholly and obviously adaptive to a very special environment. This is true of paussid structure and it will probably prove to be true of their behavior too. For these reasons the paussids should be the finest sort of material with which to study evolution and adaptation of structure and behavior in nature. I recommend them to entomologists, especially to those who live and work in the tropics.

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EXPLANATION OF FIGURES

Figures 1–18. General Form of Paussids; Wings

Fig. 1.—*Protopaussus bakeri* Heller ♂, Mt. Makiling, Luzon.

Fig. 2.—*Carabidomemnus pallidus* (Raffr.) ♀, Ghinda, Eritrea.

Fig. 3.—*Platyrhopalopsis mellyi* (Westw.) ♂, Nilgiri Hills, India.

Fig. 4.—*Paussus microcephalus* L. ♂, Ivory Coast, Africa.

Fig. 5.—*Anapaussus dama* (Dohrn) ♀, Madagascar.

Fig. 6.—*Hylotorus hottentottus* West. ♀, Zululand, Africa. Note pair of conspicuous, probably glandular openings on front of head. Eyes are small and lateral.

Fig. 7.—*Pachyteles arechavaletae* Chd. (Ozaenini), wing of ♀, Cordoba, Argentina; m = Media, cu = Cubitus, mc = median cell.

Fig. 8.—*Protopaussus bakeri* Heller ♂, Mt. Makiling, Luzon; median cell of left wing.

Fig. 9.—*Arthropterus angulatus* Macl., full wing of ♂ and vestigial wing of another ♂, Australia.

Fig. 10.—*Paussomorphus chevrolati* (Westw.), elytron and small wing-vestige of ♀ and larger wing-vestige of ♂, Abyssinia; dots show expected size of full wing.

Fig. 11.—*Paussus seriesetosus* Wasm., full wing of ♂ and reduced wing of ♀, both from Nilgiri Hills, India.

Figs. 12–18.—Median cell of left wing of Paussini: 12, *Homopterus steinbachi* Kolbe ♀, Muso, Colombia; 13, *Carabidomemnus pallidus* (Raffr.) ♀, Ghinda, Eritrea; 14, *Arthropterus* near *planicornis* Sl. ♂, Australia; 15, *Pentaplatarthrus gestroi* Kolbe ♀, Nyassaland; 16, *Platyrhopalus angustus* Westw. ♂, British Bhutan, India; 17, *Merismoderus bensoni* Westw. ♀, N.W. India; 18, *Paussus cucullatus* Westw. ♀, S. Africa.

Figures 19–31. Elytral Margin, Front and Hind Coxae, and Ventral Structure of Ozaenini and Paussids

Figs. 19–21.—Outer edge of left elytron; m = raised margin, f = subapical fold: 19 *Physea setosa* Chd. (Ozaenini) ♂, Villarica, Paraguay; 20, *Ozaena* near *lemoulti* Bänn. (Ozaenini) ♀, Saltillo, Mexico; 21, *Carabidomemnus pallidus* (Raffr.) ♀, Ghinda, Eritrea.

Figs. 22–27.—Front coxae, etc., from in front; p = prosternal process, c = coxa, t = trochanter, f = base of femur: 22, *Sphaerostylus goryi* (Cast.) (Ozaenini) ♂, Rogez, Madagascar; 23, *Protopaussus bakeri* Heller ♂, Mt. Makiling, Luzon; 24, *Carabidomemnus pallidus* (Raffr.) ♀, Ghinda, Eritrea; 25, *Cerapterus latipes* Swed. ♂, Ceylon; 26, *Paussus cucullatus* Westw. ♂, Cape Colony, Africa; 27, *Hylotorus hottentottus* Westw. ♀, Zululand, Africa.

Figs. 28–31.—Hind coxae, etc.; a = antecoxal piece of metasternum; c = coxa; 1, 2, 3 = first, second, third ventral abdominal segments; s = stridulatory file: 28, *Sphaerostylus goryi* (Cast.) (Ozaenini) ♂, Rogez, Madagascar; 29, *Physea setosa* Chd. (Ozaenini) ♂, Villarica, Paraguay; 30, *Carabidomemnus pallidus* (Raffr.) ♀, Ghinda, Eritrea; 31, *Paussus cucullatus* Westw. ♀, "Caffraria", S. Africa.

Figures 32–44. Principal Special Glandular Structures of Paussids

Figs. 32–37.—Prothorax from above, showing trichome-systems: 32, *Protopaussus bakeri* Heller ♂, Luzon; 33, *Pleuropterus westermanni* Westw. ♀, Java (lobe of posterior prothoracic margin cut away on left side); 34, *Pentaplatarthrus natalensis* Westw. ♂, Transvaal; 35, *Edaphopaussus spinicoxis* (Westw.) ♂, Uganda; 36, *Paussus microcephalus* L. ♂, Ivory Coast, Africa; 37, *Paussus boysi* Westw. ♀, Chota Nagpur, India.

Figs. 38–40.—Head, with frontal openings: 38, *Paussus cucullatus* Westw. ♂, Rhodesia; 39, *Paussus andreae* Rits. ♂, *West* Java, and (A) ♀, *East* Java; 40, *Edaphopaussus spinicoxis* (Westw.) ♂, Uganda.

Figs. 41–44.—Pygidium, with trichomes or slits: 41, *Pentaplatarthrus natalensis* Westw. ♂, Transvaal; 42, *Lebioderus goryi* Westw. ♂, Java: 43, *Paussus cucullatus* Westw. ♂, S. Africa; 44, *Edaphopaussus spinicoxis* (Westw.) ♂, Rhodesia.

Figures 45–73. Antennae of Ozaenini and Paussids

(See also Figs. 74–103)

[Camera-lucida outlines of left antenna from above; scape (first antennal segment) usually in different plane, semidiagrammatic; pedicel (second antennal segment) usually vestigial, usually shown within end of scape; flagellum, especially its segmentation, stressed.]

Fig. 45.—Ozaenini: *Pseudozaena o. orientalis* (Klug) ♂, Java; 1 = first antennal segment, or scape; 2 = second segment, or pedicel; f = flagellum.

Fig. 46.—Protopaussini: *Protopaussus bakeri* Heller ♂, Luzon.

Figs. 47–51.—Cerapterina: 47, *Megalopaussus amplipennis* Lea, Queensland, Australia (redrawn from Lea 1906); 48, *Carabidomemnus pallidus* (Raffr.) ♀, Eritrea; 49 *Cerapterus horsfieldi* Westw. ♂, Java; 50, *Homopterus hondurensis* Darl. ♂, Panama Canal Zone; 51, *Pleuropterus dohrni* Rits. ♂, Angola, Africa.

Fig. 52.—Pentaplatarthrina: *Pentaplatarthrus natalensis* Westw. ♂, Transvaal.

Figs. 53–58.—Platyrhopalina: 53, *Platyrhopalus irregularis* Rits. ♂, Java; 54, *P. angustus* Westw. ♂, British Bhutan, India; 55, *Platyrhopalopsis mellyi* (Westw.) ♂, Nilgiri Hills, India; 56, *Platyrhopalus* (*Stenorhopalus*) *tridens* Wasm., Java (redrawn from Wasmann 1917); 57, *Lebioderus goryi* Westw. ♀, Java; 58, *Euplatyrhopalus aplustrifer* (Westw.) ♀, Kanara, India.

Figs. 59–61.—Ceratoderina: 59, *Merismoderus bensoni* Westw. ♀, N. W. India; 60, *Ceratoderus oberthuri* Gestro ♂, Bombay, India; 61, *Paussomorphus chevrolati* (Westw.) ♂, Abyssinia.

Figs. 62–73.—Paussina I: 62, *Edaphopaussus favieri* (Fairm.) ♂, Algeria; 63, *E. procerus* (Gerst.) ♂, Abyssinia; 64, *E. spinicoxis* (Westw.) ♂, Rhodesia; 65, *E. hearseanus* (Westw.) ♂, S. India; 66, *E. sesquisulcatus brevicornis* (Wasm.) ♂, Chota Nagpur, India; 67, *E. henningsi* (Reichensp.) ♂, East Africa; 68, *E. rusticus* (Pér.) ♂, Africa; 69, *E. goetzei* (Kolbe) ♂, Tanganyika Ter., Africa; 70, *E. woerdeni* (Rits.) ♂, Tanganyika Ter.; 71, *E. sphaerocerus* (Afz.) ♀, Africa; 72, *Bathypaussus cultratus* (Westw.) ♂, Natal, Africa; 73, *B. jeanneli* (Reichensp.), Madagascar (redrawn from Reichensperger 1946, Fig. 26).

Figures 74–103. Antennae of Paussids (continued): Paussina II

Figs. 74–83.—African *Paussus*: 74, *P. concinnus* Pér. (redrawn from Reichensperger 1948, Fig. 18); 75, *P. cucullatus* (Westw.) ♂, Cape Colony; 76, *P. klugi* Westw. ♂, Rhodesia; 77, *P. laetus* Gerst. ♀, Abyssinia; 78, *P. germari* Westw. ♀, Abyssinia; 79, *P. cochlearius* Westw. ♀, S. Africa; 80, *P. curtisi* Westw. ♀, Cape Colony; 81, *P. cylindricornis* Pér. ♂, Kruger Nat. Park; 82, *P. microcephalus* L. ♂, Ivory Coast; 83, *P. donisthorpei* Wasm. ♂, Nyassaland.

Fig. 84.—*Falcopaussus granulatus* (Westw.) ♀, Transvaal, Africa.

Figs. 85–87.—*Hylotorus* (Africa): 85, *H. gracilis* Reichensp. (redrawn from Reichensperger 1948, Fig. 16); 86, *H. uelensis* Reichensp. ♀, Liberia; 87, *H. hottentottus* Westw. ♀, Zululand; 1 = first segment or scape, 2 = second segment or pedicel, f = flagellum; cf. Fig. 45.

Fig. 88.—*Enneapaussus howa* (Dohrn) ♀, Madagascar.

Figs. 89–91.—Madagascan *Paussus*: 89, *P. glabripennis* Jean. ♀; 90, *P. armicollis* Fairm. ♂; 91, *P. aureovellus* Reichensp. ♀.

Figs. 92–94.—*Anapaussus* (Madagascar): 92, *A. cervinus* (Kr.) ♀; 93, *A. dama* (Dohrn) ♀; 94, *A. alluaudi* (Reichensp.) (redrawn from Jeannel 1946, Fig. 23e).

Fig. 95.—S. Palearctic *Paussus*: *P. turcicus* Friv. ♂, [Turkey or vic.].

Figs. 96–103.—Oriental *Paussus*: 96, *P. seriesetosus* Wasm. ♂, India; 97, *P. boysi* Westw. ♀, India; 98, *P. rufitarsis* Westw. ♀, India; 99, *P. andreae* Rits. ♂, E. Java; 100, *P. kannegieteri* Wasm. ♂, Java; 101, *P. borneensis* Gestro ♂, Borneo; 102, *P. tagalicus* Gestro ♀, Luzon; 103, *P. occlusus* Darl. ♂, Biliran Is., Philippines.

Figures 104–119. Mouth-parts of Ozaenini and Paussids

Figs. 104–106.—Labrum, mandibles, and (dotted) labium, from above: 104, *Arthropterus sp.* (Cerapterina); 105, *Pleuropterus parallelicornis* Wasm. (Cerapterina); 106, *Enneapaussus howa* (Dohrn) (Paussina II).

Figs. 107–110.—Palpi, etc.; s = submentum, m = mentum, lm = lateral lobe of mentum, a–b = fixed segments, 1–4 = free segments of palpi: 107, *Sphaerostylus goryi* (Cast.) (Ozaenini); 108, *Pleuropterus parallelicornis* Wasm. (Cerapterina); 109, *Homopterus hondurensis* Darl. (Cerapterina); 110, *Hylotorus hottentottus* Westw. (Paussina II).

Figs. 111–119.—Mentum, etc.; s = submentum, m = mentum, lm = lateral lobe of mentum, ls = lateral sinus, ps = posterior suture: 111, *Sphaerostylus goryi* (Cast.) (Ozaenini); 112, *Protopaussus bakeri* Heller (Protopaussini); 113, *Carabidomemnus pallidus* (Raffr.) (Cerapterina); 114, *Cerapterus lafertei* Westw. (Cerapterina); 115, *Homopterus hondurensis* Darl. (Cerapterina); 116, *Pentaplatarthrus gestroi* Kolbe (Pentaplatarthrina); 117, *Lebioderus goryi* Westw. (Platyrhopalina); 118, *Ceratoderus oberthuri* Gestro (Ceratoderina); 119, *Paussus curtisi* Westw. (Paussina II).

Figures 120–141. Legs of Ozaenini and Paussids

Figs. 120–127.—Right front tibia from front, showing comb-organ if present: 120, *Goniotropis seriatoporus* (Chd.) ♂ (Ozaenini); 121, *Physea setosa* Chd. ♀ (Ozaenini); 122, *Platycerozaena panamensis* Bänn. (Ozaenini); 123, *Protopaussus bakeri* Heller ♂ (Protopaussini); 124, *Carabidomemnus pallidus* (Raffr.) ♂ (Cerapterina); 125, *Arthropterus sp.* (Cerapterina); 126, *Eohomopterus aequatoriensis* (Wasm.) (Cerapterina) (redrawn from Wasmann 1899, Pl. 3, Fig. 1, probably inaccurate); 127, *Paussus curtisi* Westw. ♀ (Paussina II).

Figs. 128–132.—Outline of right middle tibia from front, showing spurs if present (pubescence omitted): 128, *Goniotropis seriatoporus* (Chd.) ♂ (Ozaenini); 129, *Physea setosa* Chd. ♀ (Ozaenini); 130, *Protopaussus bakeri* Heller ♂ (Protopaussini); 131, *Carabidomemnus pallidus* (Raffr.) ♂ (Cerapterina); 132, *Homopterus hondurensis* Darl. ♂, with tarsus in tibial apex (Cerapterina).

Fig. 133.—Outline of femur and secondarily elongate tibia and tarsus of right middle leg of *Pleuropterus parallelicornis* Wasm. ♂ (Cerapterina).

Figs. 134–138.—Outline of right front tarsus from above (pubescence omitted): 134, *Cerapterus latipes* Swed. ♂ (Cerapterina); 135, *Eohomopterus aequatoriensis* (Wasm.) (redrawn from Wasmann 1899, Fig. 1a, probably inaccurate) (Cerapterina); 136, *Pentaplatarthrus natalensis* Westw. ♂ (Pentaplatarthrina); 137, *Platyrhopalus angustus* Westw. ♂ (Platyrhopalina); 138, *Platyrhopalopsis mellyi* (Westw.) ♂ (Platyrhopalina).

Figs. 139–140.—Outline of right middle tarsus with apex of tibia and tibial spurs if present (pubescence omitted): 139, *Ceratoderus bifasciatus* (Kollar) ♂ (Ceratoderina); 140, *Edaphopaussus spinicoxis* (Westw.) ♂ (Paussina I).

Fig. 141.—Outlines of right middle tibia and tarsus and right hind tibia (all tibial spurs lacking) of *Paussus klugi* Westw. ♂ (Paussina II).

Figures 142–153. Male Copulatory Organs of Ozaenini and Primitive Paussids

[Middle lobe from left, with left paramere in place, right paramere in place or detached; apex of middle lobe from above-right shown separately in some cases.]

Figs. 142–144.—Ozaenini: 142, *Mystropomus subcostatus* Chd., Salisbury, N.S.W., Australia; 143, *Platycerozaena panamensis* Bänn., Type, Panama Canal Zone; 144, *Physea setosa* Chd., Rio Salada, Argentina.

Fig. 145.—Protopaussini: *Protopaussus bakeri* Heller, Mt. Makiling, Luzon.

Figs. 146–152.—Cerapterina: 146, *Carabidomemnus pallidus* (Raffr.), Ghinda, Eritrea; 146½, *C.* (*Carabidobleptus*) *kirbyi* Westw., Malvern, S. Africa; 147, *Arthropterus sp.*, The Creel, Mt. Kosciusco, Australia; 148, *Homopterus hondurensis* Darl., Type, Lancetilla, Honduras; 149, *H. cunctans* Reichensp., San Julian, Venezuela; 150, *H.* (*Arthropteropsis*) *praemonens* Kolbe, San Salvador; 151, *Cerapterus latipes* Swed., Ceylon; 151½, *C. smithi* Macl., Zululand, Africa; 152, *Pleuropterus alternans* Westw., Bechuanaland, Africa.

Fig. 153.—Pentaplatarthrina: *Pentaplatarthrus natalensis* Westw., Pt. Natal, Africa.

Figures 154–171 & 172–184. Male Copulatory Organs of Derivative Paussids

[Middle lobe and parameres from left; apex of middle lobe from above-right shown separately in some cases.]

Figs. 154–157.—Platyrhopalina: 154, *Platyrhopalus angustus* Westw., Vizagapatam Dist., India; 155, *Lebioderus goryi* Westw., Soerabaja, Java; 156, *Euplatyrhopalus aplustrifer* (Westw.), Bengal, India (redrawn from Ribeiro 1930, Fig. 10); 157, *Platyrhopalopsis mellyi* (Westw.), Nilgiri Hills, India.

Figs. 158–160.—Ceratoderina: 158, *Ceratoderus bifasciatus* (Kollar), Nilgiri Hills, India; 159, *Paussomorphus chevrolati* (Westw.), Adua, Abyssinia; 160, *Merismoderus bensoni* Westw., India (redrawn from Ribeiro 1930, Fig. 7).

Figs. 161–163.—Paussina I: 161, *Edaphopaussus hearseanus* (Westw.), Nedungadu, S. India; 162, *E. spinicoxis* (Westw.), Rhodesia; 163, *Bathypaussus cultratus* (Westw.), Natal, Africa.

Figs. 164–169.—Paussina II, African *Paussus*: 164, *P. cucullatus* Westw., Algoa Bay, Cape Colony; 165, *P. laetus* Gerst., Hamae, Abyssinia; 166, *P. klugi* Westw., Portuguese E. Africa; 167, *P. curtisi* Westw., Pt. Natal; 168, *P. donisthorpei* Wasm., Mlanje, Nyasaland; 169, *P. microcephalus* L., Ivory Coast.

Fig. 170.—Paussina II, *Falcopaussus: F. granulatus* (Westw.), Natal, Africa.

Fig. 171.—Paussina II, *Hylotorus: H. hottentottus* Westw., Pretoria, S. Africa.

Fig. 172.—Paussina II, *Enneapaussus: E. howa* (Dohrn), Tananarive, Madagascar.

Figs. 173–174.—Paussina II, Madagascan *Paussus*: 173, *P. scyphus decorsei* Jean., Cotype, Région de L'Androy; 174, *P. armicollis* Fairm., Maevatanana.

Fig. 175.—Paussina II, *Anapaussus: A. elaphus* (Dohrn), Madagascar.

Fig. 176.—Paussina II, S. Palearctic *Paussus: P. turcicus* Friv., unlabeled specimen.

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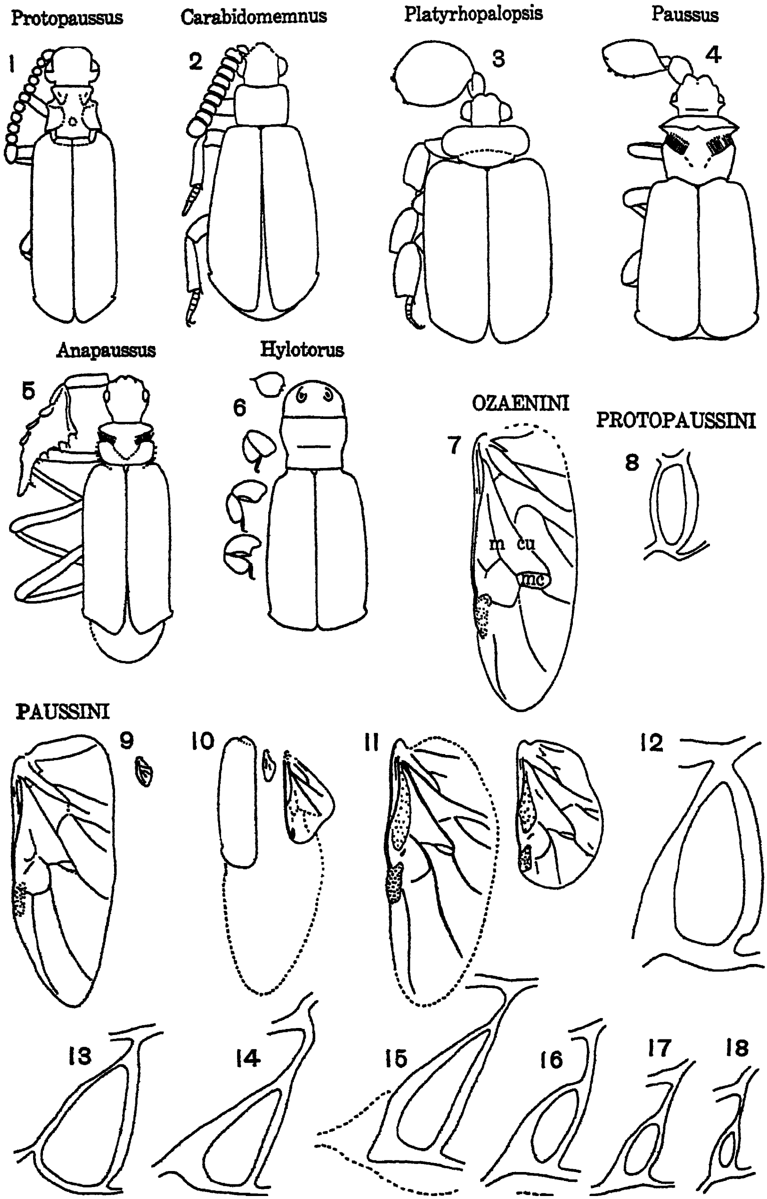

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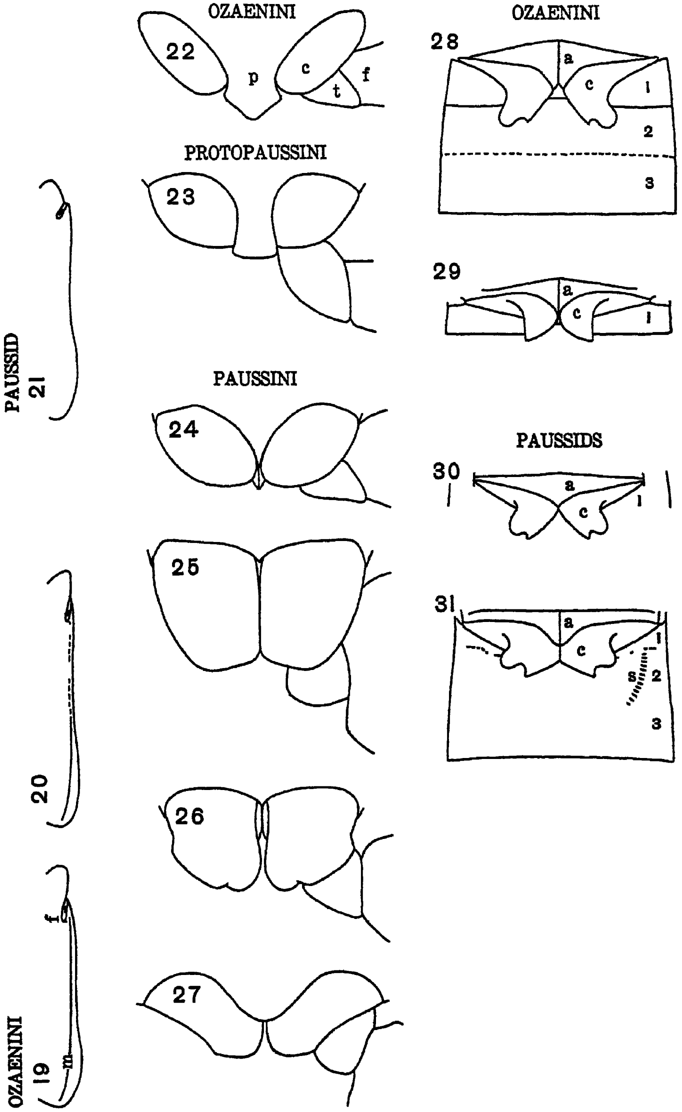

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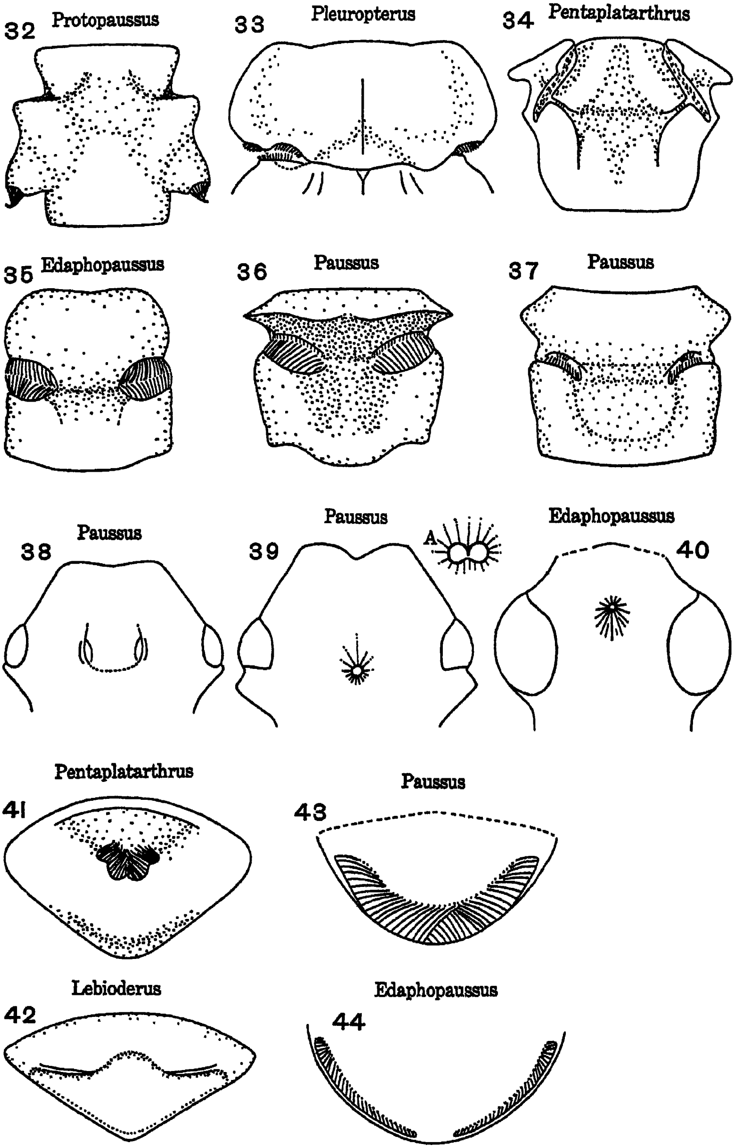

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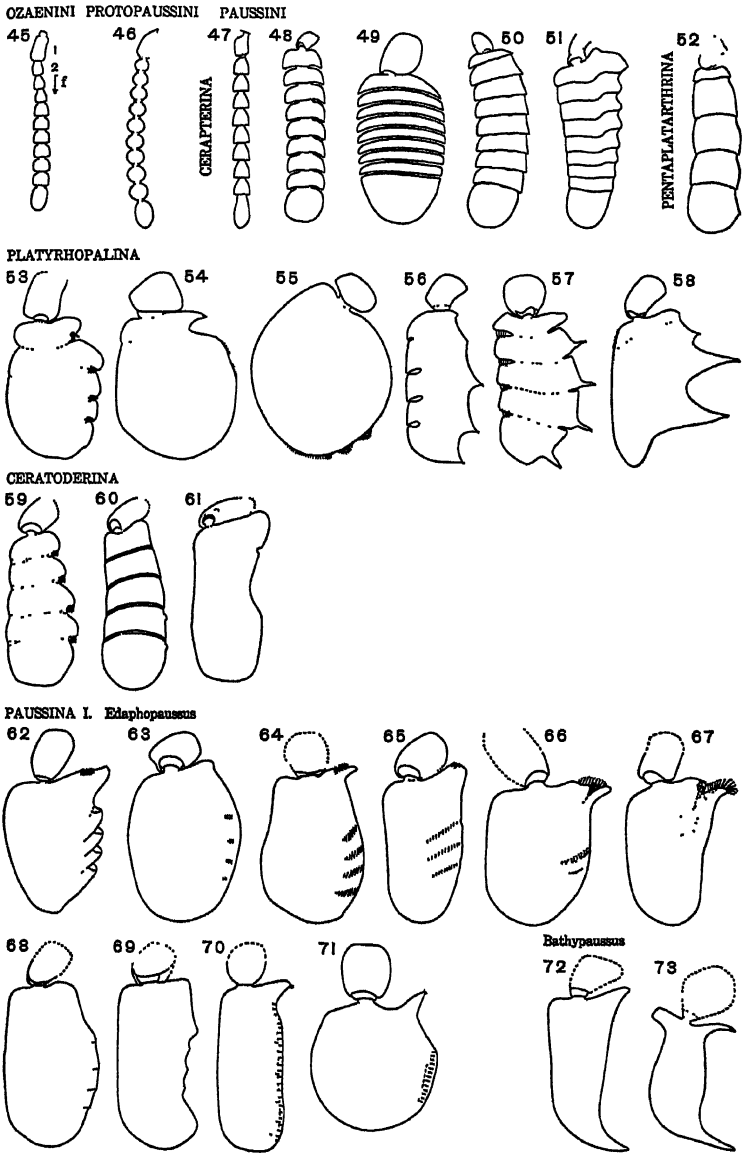

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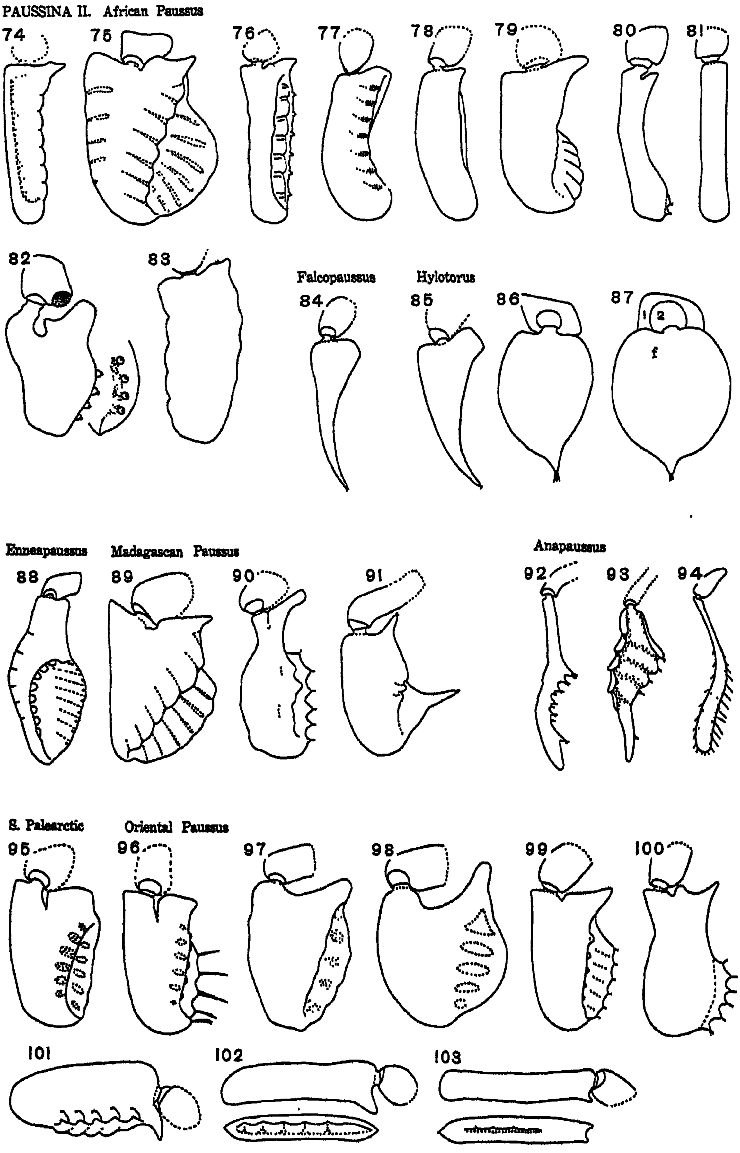

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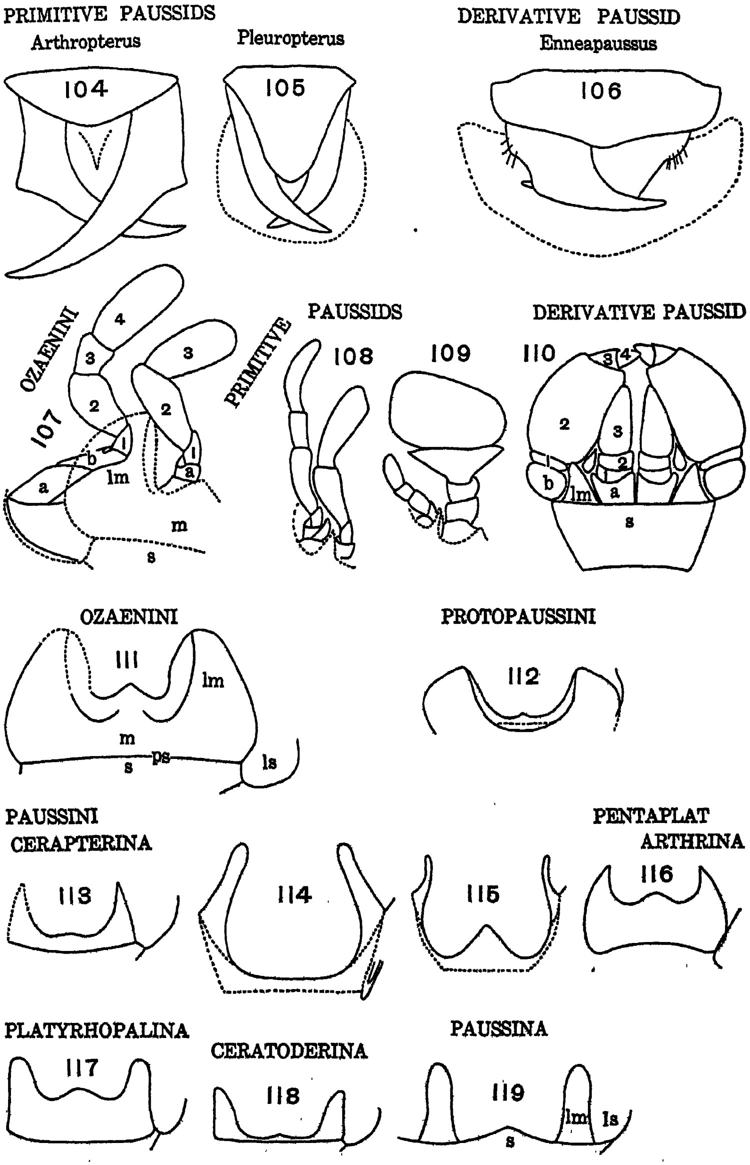

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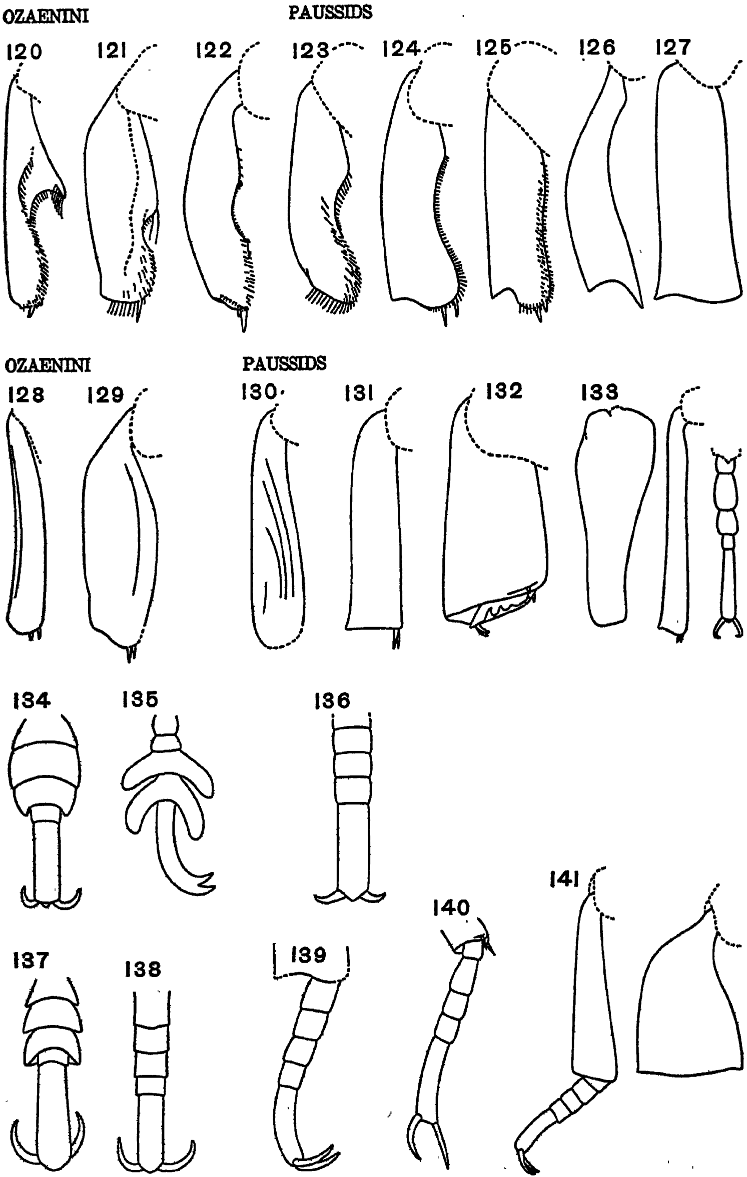

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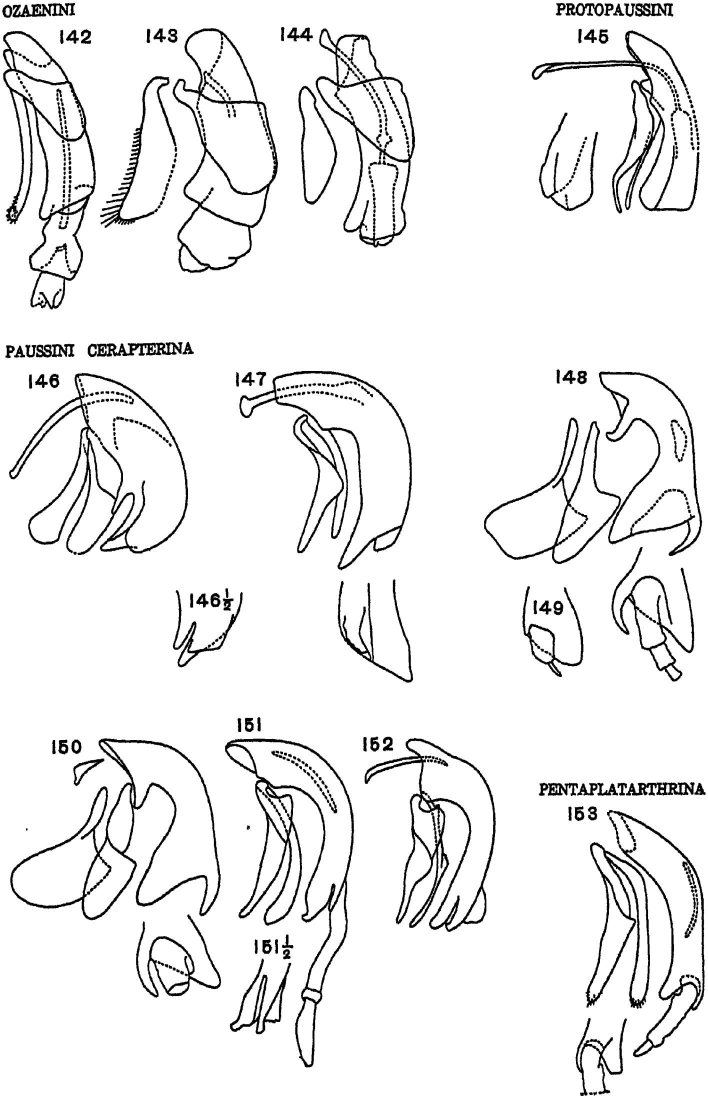

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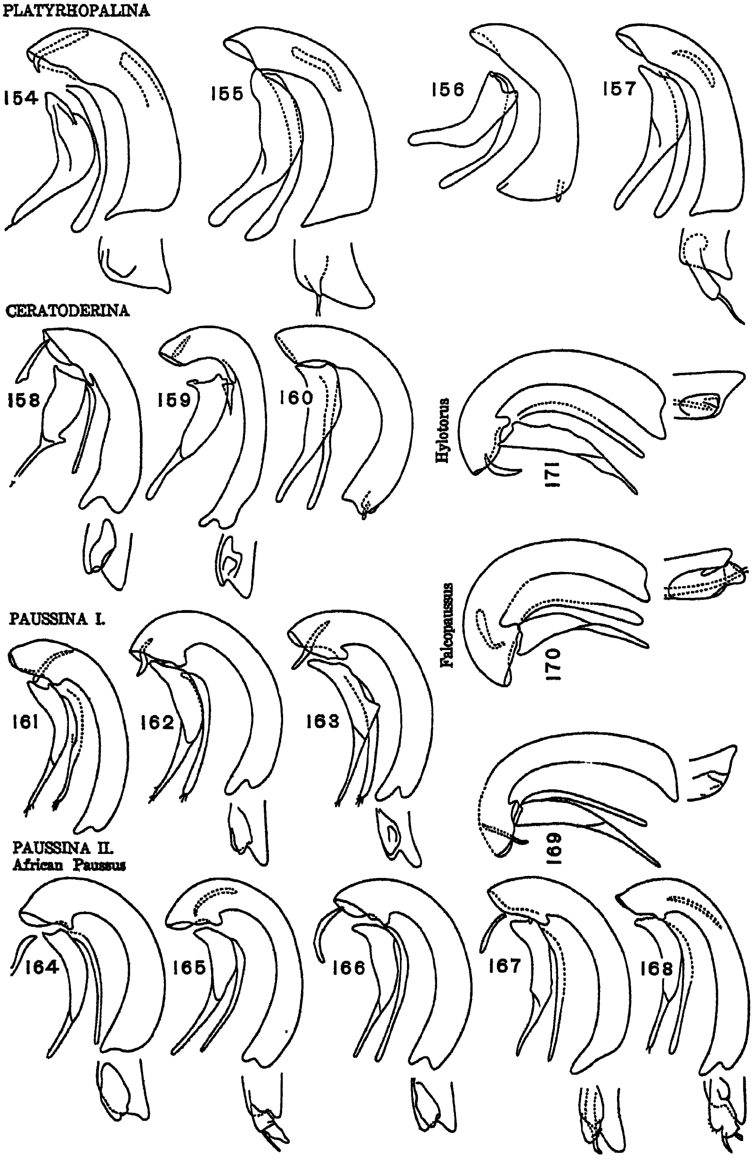
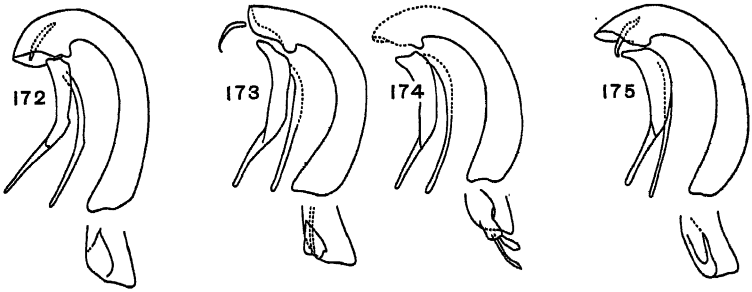


Figures 154–171. Male copulatory organs of derivative paussids.

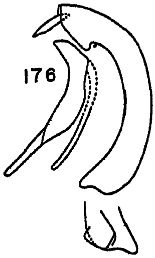
PAUSSINA II.


Enneapaussus

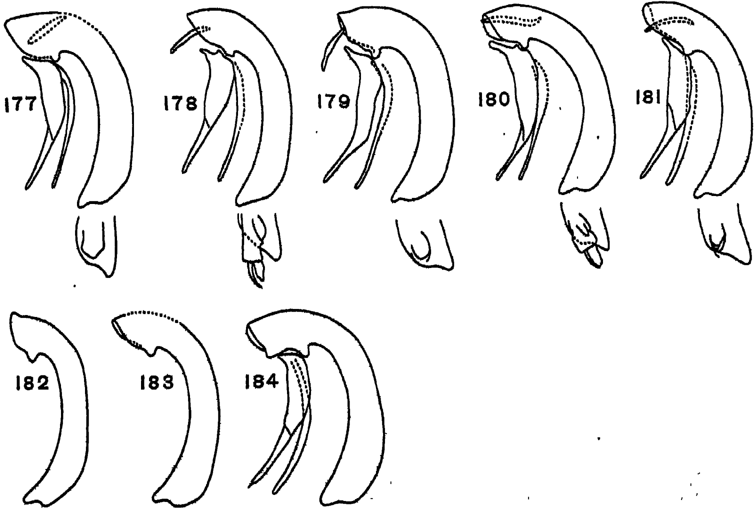
Madagascan Paussus

Anapaussus

S. Palearctic Paussus



Oriental Paussus



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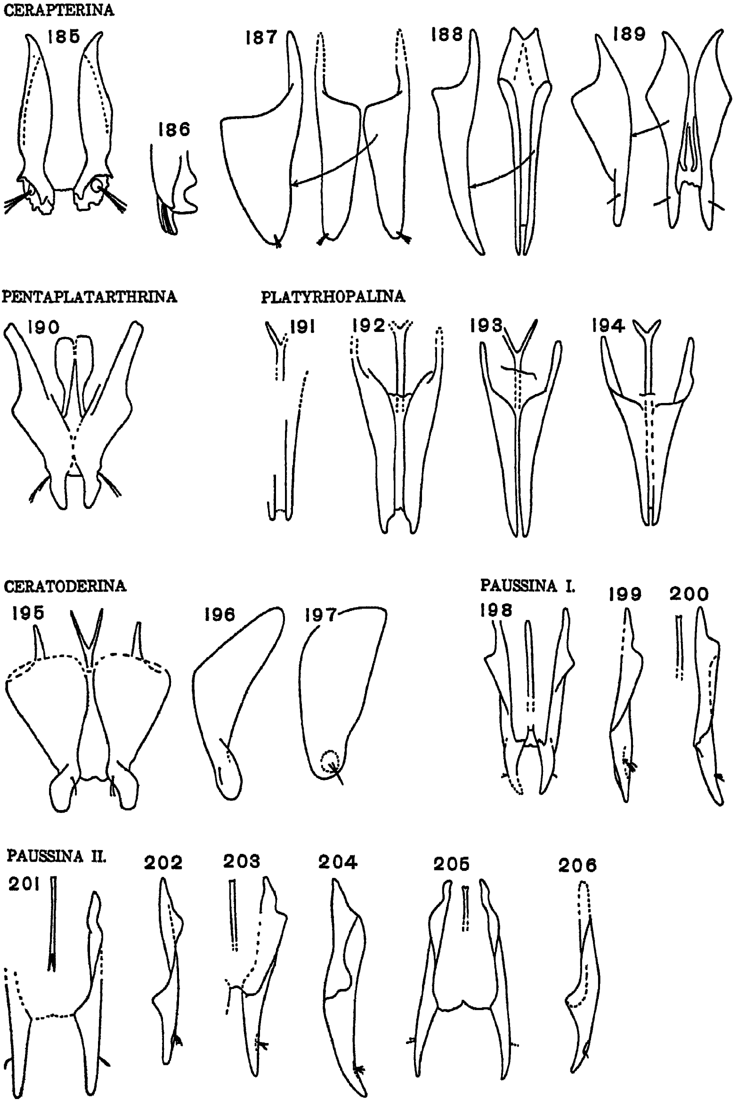

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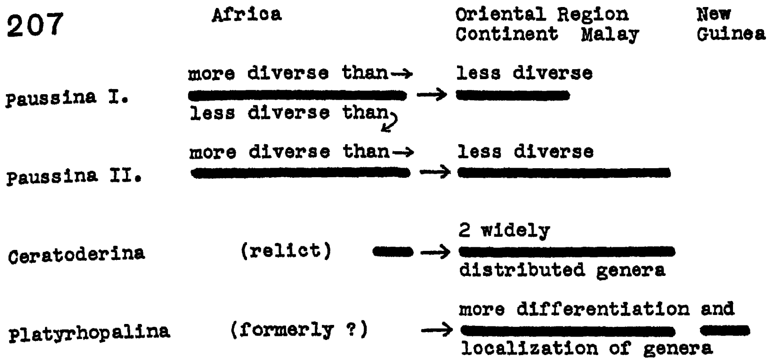
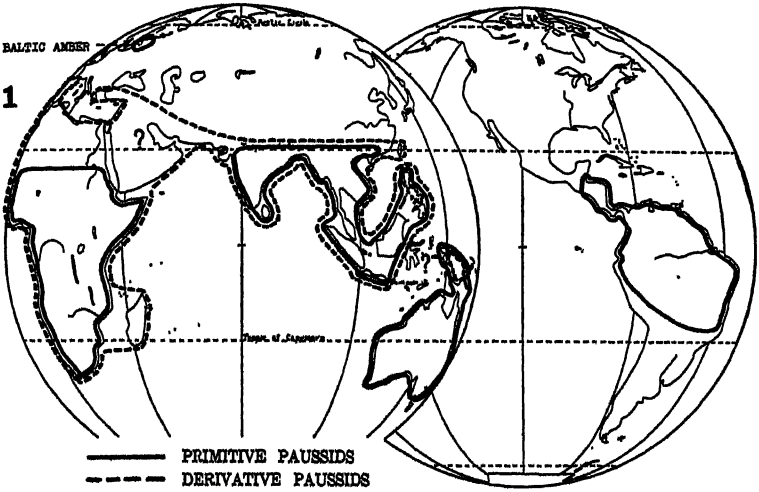
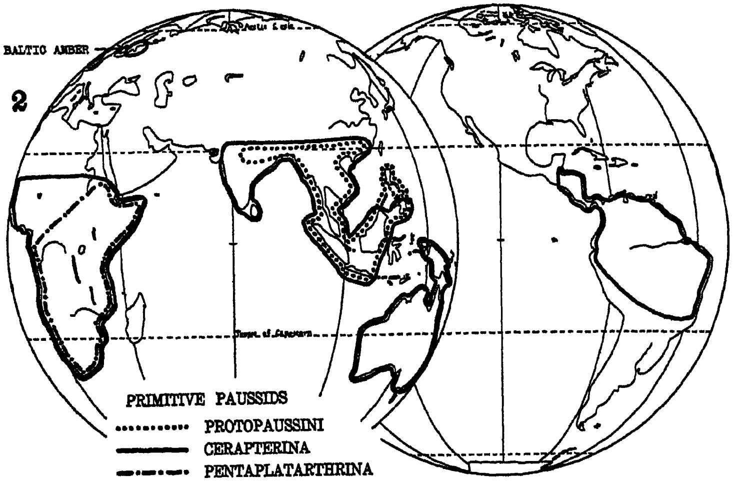
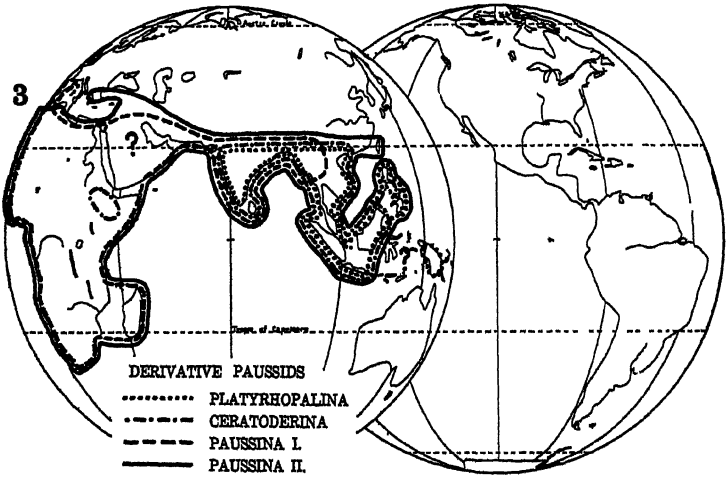


Figure 207. Diagram of hypothetical main dispersal pattern of derivative paussids, showing how present distributions (heavy lines) and degree of differentiation of existing forms suggest movement of successive groups from Africa to the Oriental Region. Read the diagram from bottom up.



Map 1. Approximate known limits of distribution of primitive and derivative paussids.





Map 2. Approximate known limits of distribution of groups of primitive paussids.

Map 3. Approximate known limits of distribution of groups of derivative paussids.

REVISION OF THE ANT TRIBE DACETINI: V.[1] THE DELIMITATION OF ARNOLDIDRIS NEW GENUS

(HYMENOPTERA: FORMICIDAE)

BY WILLIAM L. BROWN, JR.

The Biological Laboratories, Harvard University

ORECTOGNATHUS Fred. Smith

This genus consists of a few curious species inhabiting the Australasian region. Although I have amassed a considerable amount of taxonomic data on the species, including one or two forms with highly polymorphic workers, a projected trip to Australia for the study of these and other dacetine ants makes postponement of a final taxonomic treatment of *Orectognathus* preferable to an incomplete treatment at this time. There are, however, two quite distinct species-groups within the genus as it has been constituted. One of these groups is restricted, as presently known, entirely to New Guinea; and though I have seen no specimens, the excellent figures of Emery and Szabó allow me to delimit a new genus based on four previously described species.

ARNOLDIDRIS new genus

Slender Papuan species formerly included in, and closely related to, *Orectognathus*, but differing from that genus as presently restricted in the following characters: (worker)

(1) Promesonotum convex, without spines or dentiform processes.

(2) Petiole extremely elongate, very slender and gradually tapered anteriorly; node low, not, or very indistinctly, differentiated from its peduncle.

(3) Propodeal spines extremely elongate, slender and acute, strongly divergent, very nearly as long as, to longer than, the petiole.

(4) Integument usually in large part smooth and shining, the umbilicate foveolae, when present, restricted in size and distribution.

(5) Apices of occipital lobes toothed or more or less angulate as seen from lateral view.

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[1] Previous parts in this series have appeared as follows: Part I, Mushi, vol. 20, p. 1, 1949; Part II, Trans. Amer. Ent. Soc., LXXVI, p. 27, 1950; Part III, *ibid.*, LXXV, p. 43, 1949; Part IV, *ibid.*, LXXV, p. 83, 1949.

GENOTYPE: *Orectognathus chyzeri* Emery, by present designation.

This very well marked genus includes, besides the genotype, three other species originally described as *Orectognathus: biroi* (Szabó), *horvathi* (Szabó) and *longispinosus* (Donisthorpe). All are, so far as is known, confined to New Guinea and closely adjacent islands. It seems apparent that the genus is one derived from the more primitive *Orectognathus.* All four species are apparently quite rare, none having been reported from a second collection, and nothing has been recorded concerning their ethology. The males and females remain unknown.

I have not seen a single specimen referable to this genus, but fortunately three of the species are fairly well described and convincingly figured from dorsal and lateral views by Emery and Szabó, so that distinguishing characters are quite apparent. There remains, however, the possibility that the primitive polymorphic tendencies shown by certain *Orectognathus* species have been retained by one or more *Arnoldidris* species. Should this be demonstrated, certain of the names considered valid here might prove synonymous as representing different worker subcastes of the same polymorphic species. No such polymorphism is clear from the present literature.

The key presented below is taken entirely from the original descriptions and figures, and should therefore be followed with caution. The species *longispinosus* was never figured, and the rather incomplete and vague description requires supplementation.

Key to the Workers of Arnoldidris

1. Occipital lobes posteriorly or posteroventrally carinate, the carina ending in a sharp tooth 2

   Occipital lobes posteriorly more or less angulate as seen from the side, but not with a sharp tooth 3

2. Alitrunk, middle of head, petiole and postpetiole blackish; gaster, occipital lobes, anterior head and most of appendages brownish-yellow; "smooth and shining, covered with very small scatterd punctures" **longispinosus** (Donisthorpe)

   Brownish-yellow, vertex brownish, appendages yellow; gastric dorsum "mate" ....**horvathi** (Szabó)

3. Epinotal spines and petiole each about as long as the greatest width of the gaster and about twice as long as the width of the propodeum; postpetiole almost twice as long as broad ....**biroi** (Szabó)

Epinotal spines and petiole each about as long as ¾ the greatest width of the gaster and about 1½ times as long as the width of the propodeum; postpetiole only slightly longer than broad
chyzeri (Emery)

Since I have seen no specimens, the species are listed with only the necessary references and other data useful to catalogers. It is probable that the original measurements given for at least some of the species are too low, as is true of other dacetine descriptions by the same authors. Reprints of Szabó's paper cited below run from pp. 349 to 352, whereas the pagination in the source journal, followed here, runs from pp. 348 to 351.

Arnoldidris horvathi (Szabó)

Orectognathus horvathi Szabó, 1926, Ann. Mus. Nat. Hung., xxiv, pp. 348–350, figs. C, c, worker.

Type locality.—Sattelberg, Huon Gulf, New Guinea (L. Biro). Type material in the Hungarian National Museum.

Arnoldidris longispinosus (Donisthorpe)

Orectognathus longispinosus Donisthorpe, 1940, Trans. R. Ent. Soc. Lond., xci, pp. 58–59, worker.

Type locality.—Mt. Baduri, 1000 ft., Japen I. [off north coast of Dutch New Guinea] (L. E. Cheesman). *Holotype,* a unique, in the British Museum (Natural History).

Arnoldidris chyzeri (Emery)

Orectognathus chyzeri Emery, 1897, Term. Fuzetek, xx, pp. 571–572, Pl. 14, figs. 1, 2, worker.

Orectognathus chyzeri Emery, 1922, Gen. Ins., Fasc. 174, p. 318, Pl. 7, fig. 1, worker.

Type locality.—Lemien Forest near Berlinhafe, New Guinea (L. Biro). *Holotype* probably in the Hungarian National Museum, but may be in Emery Coll.

Arnoldidris biroi (Szabó)

Orectognathus biroi Szabó, 1926, Ann. Mus. Nat. Hung., xxiv, p. 350, figs. B, b, worker.

Type locality.—Sattelberg, Huon Gulf, New Guinea (L. Biro). Type material in the Hungarian National Museum.

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A SURVEY OF THE INSECTS AND RELATED ARTHROPODS OF ARCTIC ALASKA[1]

PART I

BY NEAL A. WEBER
Swarthmore College

(Plates IV–X)

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[1] The work on which this report is based was supported by the Arctic Institute of North America with funds provided by the U. S. Office of Naval Research.

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INTRODUCTION

The Arctic has generally been considered to have a depauperate insect fauna. This view is not surprising when it is recalled that insects are poikilothermic animals, animals with a variable temperature depending on the environment. The land vertebrates in this category, such as reptiles and amphibians, are notoriously sluggish in cool temperatures and the cold Arctic climate might seem to be as unfavorable for insects as for these larger animals.

Historically this view has been upheld by the early travellers in the American Arctic, who have collected or reported few insects. Indeed, the report of one of the first expeditions in the Alaskan Arctic to bring back a collection of insects, the United States Polar Expedition of 1881–83, states (1885, p. 133): "The shortness of the summer season rendered the collecting of insects difficult and unsatisfactory. . . ." Sgt. Murdock recorded 16 genera of insects and a spider from this expedition. Prior to this expedition the others in the Canadian Arctic had recorded a few scattered insects but with such incomplete locality and other data as to be largely valueless.

The Canadian Arctic Expedition of 1913–18 was the first American expedition to make any real gesture in elucidating the insect fauna and this expedition is also valuable for including a few Alaskan Arctic records, with which this discussion is especially concerned. Since the days of the Canadian Arctic Expedition, and especially during the 1940's, a large amount of material has been collected in the Canadian Arctic which is being currently studied.

The insect fauna of Greenland has become much better known through the Meddelelser om Groenland series and several hundred species have now been reported.

A brief reconnaissance in 1948 in that part of Alaska from the Brooks Range north to the Arctic Coast, hereafter referred to as the Alaskan Arctic, resulted in 102 insects and their relatives becoming known (Weber, 1948b, 1949).

In the present account " insects " will also include the related arthropods such as myriapods, spiders and mites which are generally treated with them. The term " Arctic " is taken to mean that part of North America lying beyond the boundary of coniferous trees. In Alaska that would include the coast bordering the Bering Sea and the Arctic Sea Coast south to the crest of the Brooks Range, as well as the higher parts of other Alaskan mountains such as the Alaskan Range.

ORIGIN OF ARCTIC INSECTS

Geological evidence points to connections at several times between Arctic Alaska and Siberia on the one hand and between Arctic North America, Greenland and Europe on the other hand. During the Eocene and Miocene, among the times when such connections were probable, insects were well developed. There was probably a holarctic insect fauna of modern facies in the Eocene, proliferating greatly in the warm Oligocene and the changing climate of the Miocene, only to become restricted in the Pliocene and during the glaciation of the Pleistocene. The view has been advanced that in Greenland the summits of mountains or hills (nunataks) remained essentially free during the Pleistocene glaciation (Hammer, 1944) and areas in the American Arctic are also believed to have been unglaciated so that the hardier insects could well have survived. Since the insects now present in northern areas are able to withstand extremely low temperatures it is probable that many could withstand Pleistocene temperatures. The governing factor then was probably the one always basic, distribution of plants on which animals directly or indirectly depend. Where plants were left exposed and survived, then insects probably survived with them. Such plants as lichens, fungi and mosses which are now so hardy, could have served as food for mites and Collembola at least.

Assuming that many species of insects did not survive in the Arctic during the heights of the Pleistocene glaciation, it is quite possible that they have migrated back several times during the warm interglacial periods and that we are today in such a period when the climate is becoming warmer.

The Arctic insect fauna as it now exists thus may have a double origin, one part consisting of hardy insects which are the remains of a continuous holarctic fauna, and the other part consisting of more recent migrants.

The Brooks Range

The rise of the Brooks Range, however, has created a barrier to this free movement of animal faunas. It has likely been a barrier since the close of the Cretaceous but sufficient time has elapsed for the fauna to arrive north of the mountains from the south at various warm times while there have been other opportunities from the west and east. During cold periods, the mountains may have been a real obstacle by creating a cold, sterile and rugged barrier. The last glacial period has perhaps thus made possible the last isolating factor of this type.

The Brooks Range at the present time does not appear as a substantial barrier. The broad Anaktuvuk Pass with an elevation above the sea of less than 2200 feet permits continuous movement of insects. The fact that butterflies, mosquitoes, staphylinid beetles, Collembola, mites, spiders and other arthropods were taken at 4000 feet at the margin of the pass in 1949 indicates their ability to move through the Range at any other place where plant growth is suitable, which is known to be the case at comparable and higher elevations generally. Whether the insect is winged or not makes little difference, time permitting, and Braendegaard (1946, p. 81) makes much of the motility of "aeronautical" spiders in Greenland.

Migratory Routes

Aside from direct passage through the Brooks Range, entirely feasible for Collembola, mites, spiders, and other arthropods, the eastern and western borders of this range offer direct connection from the south. The Mackenzie River taps the forested areas to the south and shore currents carrying driftwood conceivably could bring some insects to the Alaskan shores. These shore currents carrying driftwood could also carry Siberian insects here. That this is not pure speculation is indicated by the actual records of Collembola and mites in driftwood on the open Alaskan beach.

NATURE OF THE FAUNA

The preponderance of certain insect groups has been noted (Weber, 1948b). The great majority of the readily visible insects are Diptera or flies of which the notorious mosquitoes and midges are the most numerous. The insect surveys of Greenland showed species of Diptera similarly numerous and one may infer that individuals of this type may also greatly outnumber all other insects here. The situation in the Canadian Arctic is probably similar though not emphasized in the 1913–18 expedition reports.

The abundance of Diptera contrasts with that in tropical areas where the social ants and termites are generally considered to be the most numerous of what might be called the macroscopic fauna. While Diptera are ubiquitous, the insect fauna is so much more diverse that their numbers are only locally impressive, as a swarm of mosquitoes.

Collembola and mites make up the bulk of what might be termed the microscopic fauna.

ACKNOWLEDGMENTS

A study of any insect fauna is impossible without the cooperation of many specialists and the following have rendered indispensable assistance by supplying determinations:

C. P. Alexander (Tipulidae), H. E. Anthony, (Mammals), R. H. Arnett (Coleoptera), E. W. Baker (Acarina), H. S. Barber (Coleoptera), J. Bequaert (Diptera, Hymenoptera, Mallophaga, Anoplura), R. E. Blackwelder (Staphylinidae), W. J. Brown (Coleoptera), L. L. Buchanan (Coleoptera), B. D. Burks (Ephemerida), H. W. Capps (Lymantriidae), T. D. Carter (Mammals), O. L. Cartwright (Coleoptera), M. A. Cazier (Coleoptera), F. A. Chace (Crustacea), R. V. Chamberlin (Chilopoda), E. A. Chapin (Coleoptera), Kenneth Christiansen (Collembola), W. J. Clench (Mollusca), J. C. Crawford (Thripidae), P. J. Darlington (Carabidae), C. J. Drake (Heteroptera), R. Edwards (Lepidoptera),

W. D. Field (Lepidoptera), J. G. Franclemont (Lepidoptera), T. N. Freeman (Lepidoptera), A. B. Gahan (Hymenoptera), W. J. Gertsch (Araneae), G. Glance (Collembola, Protura), C. T. Greene (Diptera), A. B. Gurney (Trichoptera, Plecoptera), G. P. Holland (Anoplura), K. V. Krombein (Bombidae), George Llano (Lichens), J. MacDunnough (Lepidoptera), H. Morrison (Coccidae), C. F. W. Muesebeck (Hymenoptera, Mallophaga), M. C. Myer (Annelida), P. W. Oman (Homoptera), F. Pennell (Plants), R. Rausch (Mammals), J. A. G. Rehn (Orthoptera), W. E. Ricker (Plecoptera), J. S. Rogers (Tipulidae), H. H. Ross (Trichoptera), L. M. Russell (Homoptera), C. W. Sabrosky (Diptera), R. I. Sailer (Heteroptera), Waldo Schmidt (Invertebrates), Lloyd Spetzman (Plants), A. Stone (Diptera), H. K. Townes (Hymenoptera), W. W. Wirth (Diptera).

Relations of Insects with Plants

Insects and plants are interdependent in the Arctic as elsewhere but the emphasis may differ in the relationships.

The prevailing low stature of the plants on the tundra generally is favorable to the development of the terrestrial or hypogeic Collembola and mite fauna. These are primary feeders on fungi and their spores, and on plant tissue in general. They secure shelter under lichens and mosses and among the roots of higher plants. The high relative humidity at the surface enables these arthropods to move about freely without danger of desiccation. Collembola may be found feeding directly on the pileus of Basidiomycetes and upon other fungi. They and mites are universal and important agents in converting the vegetation to animal food. Collembola and mites are preyed upon by staphylinid and carabid beetles, by spiders and by other arthropods which in turn are preyed upon by vertebrate animals such as birds and mammals.

Heteropterous and homopterous plant-sucking insects are present but not conspicuous. Coccids on the roots of *Salix* and other plants and aphids on the leaves and stems of plants are found sparingly, as are gall insects. Lepidopterous caterpillars feed on the vegetation as is customary but aggregations have not been seen. Tenthredinids (sawflies) are not uncommon but several of the wood-boring families of Coleoptera are unknown. Although *Salix* may develop into a large bush there is evidently not sufficient continuous woody growth on the tundra generally to support most of the wood-boring insects. This is also true of the common wood ant (*Camponotus herculeanus*) which barely enters the area at Anaktuvuk Pass.

Pollination of the flowering plants appears to be accomplished in large part by flies and bumblebees. Mosquitoes have been found to carry the pollinia of ground orchids in sub-arctic Canada and may have related roles farther north. Midges and other small flies are constantly to be found in flowers, and the buzzing of bumblebees as they make their rounds is one of the few sounds of the tundra.

RELATIONS OF INSECTS WITH FISHES

Insects are the most important food for fresh-water fishes like the Arctic grayling and Whitefish. Their stomachs may literally be distended with these. Caddis worms, the young of Trichoptera, in their pebbly or woody cases, are an important component as are the nymphs of stone flies (Plecoptera). Adults of all insects are taken as they are blown or tumble into the water. Carabid beetles, curiously enough, are commonly found in fish stomachs. The beetles in their search of prey must venture out on grass blades over the water or forage at the water's edge where they are snapped up by the fish. Another unexpected component of the fish diet are snails of which a number of species have been reported (Weber, 1949).

RELATIONS OF INSECTS WITH BIRDS

While birds may be the chief insect-eaters, aside from other arthropods, of more temperate regions, they do not play a similar role in the Arctic. Ducks and shore birds, however, doubtless feed on aquatic insects and some of the land birds may be in part insectivorous. The insectivorous warblers were not noticed and most of the smaller land birds appear to be the seed-eating fringillids.

RELATIONS OF INSECTS WITH MAMMALS

One of the most significant relations insects have with mammals is perhaps that with lemmings (Weber, 1949, 1950). As the most numerous and widespread mammal of the tundra, they are everywhere involved with insects. Their nests, in which they live most of the year under the snow, have been found to harbor as many as 5,000 arthropods per nest. These are chiefly mites, Collembola and the larvae of the midge fly, *Spaniotoma.* The nests create a favorable environment as dry and sheltered sites while in addition the féces and discarded food of the lemmings serve as food for the insects.

A more spectacular relationship is that with caribou. The botfly, *Oedamagena tarandi,* may infest the animal in such numbers as to render the hide of little value to the Eskimo.

The ectoparasites such as mites, lice and ticks do not occur in such variety as in the tropics, where five species of ticks may occur on one animal (Weber, 1948a). The cold climate must render the transfer of parasites from one animal to another more difficult. The absence of ticks and fleas on Eskimo dogs has been mentioned. Tethering the dogs separately hinders transfer of them. Lice are not known from caribou according to Ferris (in conversation).

Like *Citellus* species in the United States, *Citellus parryi* subspecies of the Alaskan tundra probably feed regularly on insects though depending mostly on vegetation. Mice also doubtless feed on insects.

In addition to the botflies above, blowflies are regularly associated with the carcasses of mammals and hundreds have been taken on one lemming carcass.

THE INSECTS AND THEIR ALLIES

The insects and their allies, known up to the present from Arctic Alaska, are listed below by orders beginning with the related arthropods: spiders, mites and centipedes.

The following lists will be extended as more determinations become available from specialists and this is particularly true of Diptera which contains a number of Arctic species of particular difficulty.

The specific identifications of many are unsatisfactory because of the impossibility of comparing Eurasian type material with American material of close relationship, which may be even conspecific. These, of course, are difficulties inherent in the study of any large faunal area.

Essentially the lists consist of two sets of records from Arctic Alaska, those from the Canadian Arctic Expedition of 1913–1918, abbreviated as (C. A. E.) after the species records, and those of my 1948 and 1949 collecting, abbreviated as (N. A. W.). A few other records are listed more fully including those from Greenland by M. Hammer, abbreviated as (M. H.). Canadian Arctic records are included when the species is known from Arctic Alaska.

The United States National Museum will be the repository for the most complete set of specimens collected in Arctic Alaska by the author. The identifications have been made by many specialists and several have exercised their privilege of retaining specimens; this includes several specimens not represented in the National Museum set because of scarcity of material. Duplicate specimens will be deposited in the Canadian National Museum, Ottawa, Museum of Comparative Zoology, Cambridge, Mass., Academy of Natural Sciences of Philadelphia and American Museum of Natural History, New York.

The following insects were recorded by the United States Polar Expedition of 1881–83 from Pt. Barrow and are historically valuable although the names and classification may differ from those now in use:

NEUROPTERA (TRICHOPTERA).—*Leptocerus* sp., *Oligoplectrum morosum?.*

COLEOPTERA.—*Amara obtusa, Chrysomela montivagans.*

DIPTERA.—*Scatophaga* sp., *Cordylura* sp., *Chironomus* spp., *Anthomyia* spp., *Ctenophora* spp., *Oedemagena tarandi, Urocerus flavicornis* and a tachinid fly.

LEPIDOPTERA.—*Laria rossii* and an Arctian moth.

HYMENOPTERA.—*Bombus moderatus, Bombus sylvicola.*

" A species of Podurid and a spider were also turned over to Professor Riley ". The *Scatophaga,* " probably undescribed ", were swarming around the bodies of dead Eskimos and may be what is recorded below as *Scopeuma vulpinum* or another species in the list. *Chironomus* of three species were abundant at all tundra pools and had aquatic larvae. They may have included the *Spaniotoma* listed below. The *Laria* emerged from a cocoon in the house. While the author of the report is Lt. P. H. Ray, the collector appeared to be Sgt. John Murdock of the Signal Corps, and it was the well-known Professor C. V. Riley who identified the specimens. They should be in the U. S. National Museum collection.

ARACHNIDA—Order ARANEAE

(Spiders)

Spiders are common tundra animals, capable of moving about at freezing temperatures. They are generally predatory and scurry over the ground. In the mountains of the Brooks Range they ascend to heights of over 4,000 feet where they form webs to trap mosquitoes, butterflies and moths and other winged insects. They also prey on the wingless forms on the tundra. The species are widely distributed because of their hardiness and widespread food. It is probable that several summers are needed to mature the species so that at any one time mostly immatures, difficult of identification, will be found.

LYCOSIDAE

Pardosa tesquorum Odenwall.—Alaska: Anaktuvuk, 1948; Umiat, Colville R., July 3, 1949, 2 males, 1 female, 7 im., running freely on dryish tundra on top of valley; 3 males, egg sacs, top of Mt. Umiat; 1 female, attacking live fly, 1 female, egg sac, Anaktuvuk Pass (68° 20′ N.), July 8, 1949, open tundra; 1 female, egg sac, Anaktuvuk Pass (151° 30′ W.), July 9, 1949, sand dune along river. (N. A. W.)

Pardosa varians Gertsch.—Alaska: Anaktuvuk Pass, 1948, 1 female, egg sac (68° 20′ N.) sand dunes along river, July 9, 1949; 1 female, egg sac (151° 30′ W.) open tundra, July 6, 1949; 1 female, egg sac, foraging at 3200 feet, July 5, 1949; 1 female, egg sac, open tundra, July 23, 1949. (N. A. W.) Known from northwestern Canada.

Pardosa undescribed sp.—1 female, Anaktuvuk Pass 4000 feet, July 7, 1949. (N. A. W.)

Pardosa lapponica Thorell?.—Anaktuvuk, 1948. A European species. (N. A. W.)

Pardosa tristis Thorell.—Anaktuvuk, 1948. Known from the Rocky Mountains. (N. A. W.)

Pardosa glacialis Thorell.—Umiat, Colville R., 1 male, July 11, 1949, summit of Mt. Umiat. (N. A. W.)

Pardosa concinna Thorell.—Umiat, Colville R., 1 male, July 2, 1949, river bottom. (N. A. W.)

Pardosa sp. ? *groenlandica* group.—Anaktuvuk Pass, 2 females; 1 im., July 7, 1949, foraging at 3200 feet. (N. A. W.)

Tarentula sp. ?.—Umiat, Colville R., 1 female with egg case, July 3, 1949, elevation 850 feet, slope of Mt. Umiat. (N. A. W.)

Tarentula pictilis Emerton.—Umiat, Colville R., 1 male, 1 female, 1 im., July 3, 1949, driest part of tundra on top of valley; 1 penultimate male, top of Umiat Mt. 950 feet. (N. A. W.)

Tarentula hamiltoni Chamberlin and Ivie.—Anaktuvuk Pass, 1 female, egg sac, July 9, 1949, large spiders, each with egg case, under small stones on valley tundra. (N. A. W.)

Arctosa alpigena Doseschall.—Umiat, Colville R., 1 im., July 25, 1949, lemming runways. (N. A. W.)

ARGIOPIDAE

Aranea sericata Clerck.—Anaktuvuk, 1948, two spiders in neat cocoon with dead leaves attached. A European and Siberian species. (N. A. W.)

Tetragnatha extensa Linnaeus.—Anaktuvuk, 1948. A European and Siberian species.

Tetragnatha laboriosa Hentz.—Anaktuvuk Pass, 1 female, July 23, 1949, meadow beside lake. (N. A. W.)

Epeira sericata Clerck.—Alaska (68° 20′ N., 151° 30′ W.), 1 female, July 25, 1948, under *Salix* (N. A. W.) ; 1 subadult male (69° 50′ N., 156° W.), July 16, 1949, open tundra. (N. A. W.)

Aculepeira aculeata Emerton.—Anatuvuk Pass, 3500 feet (68° 20′ N., 151° 30′ W.), July 22, 1949, 1 female and 1 immature female spider with orb web on jagged mountain slope. (N. A. W.)

Aculepeira sp., undescribed.—Anaktuvuk Pass (68° 20′ N., 151° 30′ W.), July 7, 1949, 1 female 1 pen. male 1 im. female, 3150 feet, with orb web, with fresh-caught male *Aedes*; 1 pen. male, 2650 feet, orb web. (N. A. W.)

CLUBIONIDAE

Micaria sp., undescribed.—McKinley Park, Station, August 4, 1949, 1 female. (N. A. W.)

Clubiona sp., undescribed.—Anaktuvuk Pass (68° 20′ N., 151° 30′ W.), July 23, 1949, 1 female, tundra along river. (N. A. W.)

DYCTYNIDAE

Dictyna sp.—Anaktuvuk, 1948. (N. A. W.)

GNAPHOSIDAE

Gnaphosa orites Chamberlin.—Umiat (Per Scholander), 1948. A European and probably Siberian species. (N. A. W.)

Gnaphosa muscorum L. Koch.—Umiat, Colville River, July 3, 1949, 1 female 1 im. male, top of valley, running on dryish tundra; 1 female, 750 feet, large spider feeding on smaller (male ?). (N. A. W.)

HAHNIIDAE

Hahnia glacialis Soerensen.—Anaktuvuk Pass (68° 20′ N., 151° 30′ W.), July 5, 1949, 1 male, 1 female, 4 juv., foraging at 3200 feet. (N. A. W.)

LINYPHIIDAE

Coryphaeolana sp.—Pt. Barrow, 1948. (N. A. W.)

Hilaira curvitariis Sorensen.—Pt. Barrow, 1948, common on tundra. Known from northern Canada and Greenland. (N. A. W.)

"*Erigone*" *chilkatensis* Chamberlin and Ivie?.—Anaktuvuk, 1948, under small rocks with south exposure on island in river bed. (N. A. W.)

Erigone sibirica Kulczynski ?.—Anaktuvuk, 1948. A Siberian and European species. (N. A. W.)

Erigone psychrophila Thorell.—Pt. Barrow, 1948, among grass and herbs on tundra. (N. A. W.)

"*Erigone*" sp. A.—Pt. Barrow, 1948. Crawling slowly on hillock of tundra which had a surface temperature of 36°, with patches of snow in vicinity. (N. A. W.)

"*Erigone*" sp. B.—Anaktuvuk, 1948. Under small rocks with south exposure on island in river bed. (N. A. W.)

THOMISIDAE

Xysticus labradoriensis Keyserling.—Umiat, Colville River, July 11, 1949, 1 male, 950 feet on Umiat Mt. (N. A. W.)

ARACHNIDA—Order ACARINA

(Mites and Ticks)

No ticks are recorded from Arctic Alaska or Canada and this is hardly surprising in view of their generally tropical nature, Africa being the home of the majority.

Mites, on the other hand, are exceedingly widespread and abundant in all parts of the Arctic where tundra exists, perhaps being scarce or absent from the Greenland ice-cap.

Two species are listed by the Canadian Arctic Expedition from Arctic Alaska. The determinations of the 1948 specimens arrived too late to be included in the 1949 report (Weber, 1949) but amounted to 19 unidentified species which were sent to Denmark for additional study. Thousands of specimens were taken in 1949.

Of 37 genera listed by Hammer from Greenland, eight were taken on the 1948 work.

In view of the difficulty of securing any but generic identifications for mites, where a genus has been identified from Arctic Alaska, the Greenland and other distribution of the known species are added. Some of these species will likely be identified from Alaska in the future.

In addition to the collector's initials (C. A. E.) and (N. A. W.), the new initials (M. H.) refer to Marie Hammer as collector and as published reference.

RHAGIDIIDAE

Rhagidia gelida Thorell.—Canada: Bernard Harbour, Dolphin and Union strait, Northwest Terr., August 16, June 19, 1915, in rotten driftwood and under stones. (C. A. E.)

Rhagidia sp.—Alaska: Point Barrow, August 22, 1948. (N. A. W.)

HYPOCTHONIIDAE

Brachythonius berlesi Willm.—East Greenland, Sweden, Germany, Italy, North America. (M. H.)

Brachythonius zelawaiensis Selln.—East Greenland, Sweden, Germany, North America. (M. H.)

Brachythonius brevis Mich.—East and west Greenland, Spitsbergen, Lapland, Scotland, England, Ireland, Denmark, Germany, Switzerland, Italy. (M. H.)

Brachythonius sellnicki Thor.—East Greenland, Spitsbergen. (M. H.)

Brachythonius grandis Sell.—West Greenland. (M. H.)

Brachythonius sp.—Alaska: Anaktuvuk Pass, July 7, 9, 1949; Umiat Mt., July 11, 1949, at 900 feet. (N. A. W.)

CAMISIIDAE

Nothrus borussicus Sell.—East and west Greenland, Iceland, Germany, Austria. (M. H.)

Nothrus bicilatus C. L. Koch.—Iceland. (M. H.)

Nothrus silvestris Nic.—Iceland (M. H.)

Nothrus sp.—Alaska: Anaktuvuk Pass, August 30, 1948; Point Barrow, August 22, 1948, from lemming runways. (N. A. W.)

TYDEIDAE

Tydeus sp.—Alaska: Point Barrow, August 22, 1948, from tundra, turfy ground and lemming runways. (N. A. W.)

ZERCONIDAE

Zercon sp.—Alaska: Point Barrow, August 22, 1948, from turfy ground and lemming runways. (N. A. W.)

HERMANIIDAE

Hermannia reticulata Thor.—East and west Greenland, Jan Mayen, Bear Island, Spitsbergen, Novaja Semlja, The Faroes, England, Ireland, Denmark, Holland, France, Italy. (M. H.)

Hermannia scabra L. Koch.—West Greenland, Iceland, Bear Island, Novaja Semlja, Arctic Siberia. (M. H.) Alaska: Pt. Barrow, August 22, 1948, from tundra surface and from turfy soil and debris of lemming runways. (N. A. W.) "Not thus far identified from Canada" (Hammer).

Hermannia sp.—Alaska: Anaktuvuk Pass, August 30, 1949; Point Barrow, August 22, 1948. (N. A. W.)

ERYTHRAEIDAE

Leptus sp.—Alaska: Umiat Mt., June 11, 1948, attacking a weevil (*Apion* sp.) (N. A. W.)

ORIBATULIDAE

Zygoribatula sp.—Alaska: Anaktuvuk Pass, August 30, 1948. (N. A. W.)

Lygoribatula exilis (Nic.) (*Oribatula exilis*).—Alaska: Anaktuvuk, August 30, 1948, from tundra surface at base of dwarf *Salix*. (N. A. W.)

BDELLIDAE

Bdella arctica Thorell.—Canada: Young Point, July 22, 1916, on rocks on beach; Bernard harbour, Northwest Terr., August 23, 1915, under stones at beach. (C. A. E.)

Bdella frigida Banks.—Canada: Herschel Island, Yukon Terr., July 28, 1916, on ground. (C. A. E.)

Bdella decipiens Thorell.—Canada: Bernard Harbour, Northwest Terr., May 18, 1915, under stones. (C. A. E.)

Bdella sp.—Alaska: Anaktuvuk Pass, August 30, 1948. (N. A. W.)

CERATOZETIDAE

Ceratoppia bipilis Herm. var. *sphaerica* L. Koch.—Greenland, Spitsbergen, Canada and North America, Lapland, northern Russia, Arctic Siberia. (M. H.)

Ceratoppia sp.—Alaska: Anaktuvuk, August 30; Point Barrow, August 22, 1948. (N. A. W.)

Trichoribates trimaculatus C. L. Koch.—East and west Greenland, Iceland, Spitsbergen, Lapland, Arctic Siberia, Switzerland. (M. H.)

Trichoribates incisellus Kramer.—East and west Greenland, Iceland, Spitsbergen. (M. H.)

Trichoribates setiger Trgdh.—Iceland. (M. H.)

Trichoribates monticola Trgdh.—Iceland. (M. H.)

Trichoribates novus Sell.—Iceland. (M. H.)

Trichoribates sp.—Alaska: Point Barrow, August 23, 1948, turfy ground and lemming runways. (N. A. W.)

Trichoribates sp.—East and west Greenland. (M. H.)

BELBIDAE (= Eremaeidae)

Eremaeus oblongus C. L. Koch.—North America, west Greenland, Iceland, Lapland. (M. H.)

Eremaeus sp.—Alaska: Anaktuvuk Mt., July 7, at 3950 feet; Anaktuvuk valley floor, July 9; Umiat Mt., July 11, 1949, at 915 feet. (N. A. W.)

Oppia translamellata Willm.—East and west Greenland, Iceland, Spitsbergen, Lapland, Sweden, Germany. (M. H.) Alaska: Anaktuvuk, August 30, 1948, from tundra surface at base of dwarf *Salix*; 3950 feet on mt., July 7, 1949, under lichens, mosses and higher plants; Umiat, July 11, 1949, south exposure of 900-foot bluff. (N. A. W.)

Oppia unicarinata Paoli.—Iceland. (M. H.)

Oppia bicarinata Paoli.—Iceland. (M. H.)

Oppia ornata Oudms.—East and west Greenland, Iceland, Spitsbergen, Sweden, Denmark, Germany, Austria. (M. H.)

Oppia fallax Paoli.—Spitsbergen. (M. H.)

Oppia fallax v. *obsoleta* Paoli.—Iceland. (M. H.)

Oppia falcata Paoli.—Iceland. (M. H.)

Oppia maritima Willm.—East Greenland, Germany. (M. H.)

Oppia splendens C. L. Koch.—Iceland, England, Ireland, Germany, Switzerland, Italy, North Africa, North America, Hawaii. (M. H.)

Oppia nitens C. L. Koch.—Iceland. (M. H.)

Oppia subpectinata Oudms.—Iceland. (M. H.)

Oppia quadricarinata Mich.—East and west Greenland, Iceland, England, Germany, Switzerland, Italy, North America. (M. H.)

Oppia neerlandica Oudms.—East and west Greenland, Iceland, Spitsbergen, Lapland, Sweden, Germany, North America.

Oppia sp.—Alaska: Anaktuvuk Pass, August 30, 1948. (N. A. W.)

Oppia sp.—Alaska: Anaktuvuk Mt., July 7, at 3950 feet; Anaktuvuk valley floor, July 9; Umiat Mt., July 11, 1949, at 915 feet. (N. A. W.)

Belba gracilipes Kulcz.—West Greenland. (M. H.)

Belba tenuipes Mich.—West Greenland. (M. H.)

Belba clavipes Herm.—Iceland. (M. H.)

Belba compta Kulcz.—Iceland. (M. H.)

Belba tatrica Kulcz.—West Greenland. (M. H.)

Belba tecticola Mich.—Iceland. (M .H.)

Belba ursina Thor.—Spitsbergen. (M. H.)

Belba trägardhi Graverson.—West Greenland. (M. H.)

Belba sp.—Alaska: Anaktuvuk Mt., July 7, 1949, at 3950 feet, from humus about lichens, mosses, and higher plants on fully exposed jagged rocks facing the pass. (N. A. W.)

Belba sp.—East Greenland. (M. H.)

TETRANYCHIDAE

Bryobia praetiosa Koch.—Canada: Bernard Harbour, Northwest Terr., July 19, 1915, on dead *Salix* leaves; October 4, 1914, under stones. (C. A. E.)

Bryobia sp.—Alaska: Point Barrow, August 22, 1948, turfy ground and lemming runways. (N. A. W.)

GAMASOLAELAPTIDAE

Gen. et sp.—Alaska: Anaktuvuk Pass, August 30, 1948. (N. A. W.)

EUPODIDAE

Eupodes sp.—Alaska: Point Barrow, August 22, 1948, turfy ground and lemming runways. (N. A. W.)

Platynothrus sp.—Alaska: Pt. Barrow, August 22, 1948, debris of lemming runways; Anaktuvuk, August 30, 1948, tundra surface at base of dwarf *Salix*. (N. A. W.)

Notaspis sp.—Alaska: Umiat Mt., 900 feet, July 11, 1949, south exposure of bluff. (N. A. W.)

CHILOPODA

(Centipedes)

Centipedes are more commonly associated with warm, dry localities but two species are recorded by the Canadian Arctic Expedition from Arctic Alaska (Nome and Teller). Three species were taken in 1948 at Anaktuvuk Pass, including a new genus, and many specimens were taken in 1949 which have not yet been identified. These animals appear to prefer well-drained sites with considerable exposure and may be found under stones with very little organic matter in the rubble of talus slopes. They are predatory and could readily find mites and Collembola over the whole Arctic slope were they not less tolerant of cold, damp sites.

CHILENOPHILIDAE

Cryophilus alaskanus Chamberlin.—Alaska: Nome, August, 1916. (C. A. E.)

LITHOBIIDAE

Arebius integrior Chamberlin.—Alaska: Anaktuvuk Pass, August 26, 1948, tundra margin of river. (N. A. W.)

Escimobius cryophilus Chamberlin.—Alaska: Anaktuvuk Pass, August 30, 1948, valley tundra. (N. A. W.)

Ezembius stejnegeri (Bollman).—Alaska: Teller, July 31, 1913; believed widespread in this general region and to occur on the Pribilofs. (C. A. E.)

SCHENDYLIDAE

Escaryus paucipes Chamberlin.—Alaska: Anaktuvuk Pass, August 30, 1948, valley tundra. (N. A. W.)

INSECTA

Order COLLEMBOLA

The importance of Collembola or springtails has been previously noted. They are common and widespread animals of the tundra. The Canadian Arctic Expedition listed four species from Arctic Alaska and a total of 10 from Canada. Thirty-six species are listed from Greenland, including 13 species also occurring in Arctic Alaska. From the 1948 and 1949 field work 34 species have already been determined with more material yet to be worked on. Twenty-two of these were taken from lemming nests and runways.

In addition to the collector's initials (C. A. E.) and (N. A. W.) the new initials (M. H.) refer to Marie Hammer as collector and as published reference.

ANURIDAE

Anurida granaria Nicolet.—Greenland: Upernavik, S. E. coast, Scoresby-sound, Franz Joseph Fjord, N. E. coast, 1931–39. (M. H.)

Anurida undescribed species 1.—Arctic Alaska: Umiat, July 4, 1949, tundra of valley floor (N. A. W.); Fish Creek; lat. 70° 20′ N., long. 151° 30′ W., July 16, 1949, lemming nest (*Dicrostonyx rubricatus*) on wind-swept tundra. (N. A. W.)

Anurida undescribed species 2.—Arctic Alaska: Oumalik, lat. 69° 50′ N., long. 156° 00′ W., July 16, 1949, tundra on bluff of lake; Pt. Barrow, July 13, 1949, census of lemming nest (*Dicrostonyx rubricatus*). (N. A. W.)

BRACHYSTOMELLIDAE

Brachystomella parvula Schaffer.—Arctic Alaska: Oumalik, lat. 69° 50′ N., 156° 00′ W., July 15-16, 1949, tundra on bluff of lake. (N. A. W.)

A cosmopolitan species, living "concealed in the damp soil of various fields, and only rarely appears on the surface of the ground in moist terrains. . . . " (Stach). It may also occur on sea-shores.

Willemia anophthalma Borner.—Greenland: Upernavik, Disco Fjord, Godthaab-Julianehaab, S. E. coast, Kangerdlugssuaq, Scoresbysound, Franz Joseph Fjord, N. E. coast, 1931-39. (M. H.)

Willemia similis Mills.—Arctic Alaska: Fish Creek, lat. 70° 20′ N., long. 151° 30′ W., July 16, 1949, lemming nest (*Dicrostonyx rubricatus*) on windswept tundra. (N. A. W.) Known from Iowa and Kansas.

ENTOMOBRYIDAE

Entomobryra comparata Folsom.—Arctic Alaska: Fish Creek, lat. 70° 20′ N., long. 151° 30′ W., July 16, 1949, lemming nest (*Dicrostonyx rubricatus*) on windswept tundra (N. A. W.); Demarcation Pt., May 16, 1915, driftwood on tundra. (C. A. E.) Arctic Canada; Bernard Harbour, N. W. Terr., May, 1915, under loose stones. (C. A. E.)

Lepidocyrtus cymeus Tullberg.—Arctic Alaska: Demarcation Pt., May 16, 1914, under driftwood on high, dry tundra. (C. A. E.) Greenland: Godthaab-Julianehaab region, 1931-39. (M. H.)

This species also found in Siberia, N.E. Africa, and Bismark Archipelago.

Lepidocyrtus lanuginosus Omelin.—Greenland: Franz Joseph Fjord Region, 1931–39. (M. H.)

Lepidocyrtus sp., undescribed.—Arctic Alaska: Oumalik, lat. 69° 50′ N., long. 156° 00′ W., July 15–16, 1949, tundra on bluff of lake. (N. A. W.)

Tomocerus flavescens Tullberg.—Arctic Alaska: Umiat, July 4, 1949, tundra composed of mostly *Eriophorum*. (N. A. W.); Oumalik, lat. 69° 50′ N., long. 156° 00′ W., July 15–16, 1949, tundra on bluff of lake. (N. A. W.); Anaktuvuk Pass, July 6, 1949, humus at base of *Salix*. (N. A. W.)

HYPOGASTRURIDAE

Ceratophysella armatus Nicolet.—Arctic Alaska: Anaktuvuk Pass, July 6, 1949, humus at base of *Salix*; Pt. Barrow, July 13, 28, 30, 1949, lemming nests and runways (*Dicrostonyx rubricatus*) on tundra; Oumalik, lat. 69° 50′ N., long. 156° 00′ W., July 15-16, 1949, tundra on bluff of lake. (N. A. W.); Greenland: Upernavik, Disco Fjord, Godthaab-Julianehaab, S. E. coast, Scoresbysound, Kangerdlugssuaq, Franz Joseph Fjord, N. E. coast, 1931–39. (M. H.)

A cosmopolitan species found to 2800 m. in the Swiss Alps and sometimes found in snow fields but not considered by Stach to be a " proper snow species."

Hypogastrura manubrialis Agren.—Arctic Alaska: Pt. Barrow, June 30, 1949, lemming runways on tundra. (N. A. W.); Greenland: Franz Joseph Fjord region, N. E. coast, 1931–39. (M. H.)

Hypogastrura purpurascens Lubbock.—Greenland: Upernavik, Disco Fjord, Godthaab-Julianehaab, Scoresbysound, Franz Joseph Fjord, N. E. Coast, 1931-39. (M.H.) Probably cosmopolitan.

Hypogastrura sensilis Folsom.—Arctic Alaska: Pt. Barrow, June 28, 1949, July 13, 1949, lemming nests (*Dicrostonyx rubricatus*) on tundra. (N. A. W.)

Hypogastrura tullbergi Schaffer.—Greenland: Thule region, Franz Joseph Fjord region, 1931–39. (M. H.)

Hypogastrura viatica Tullberg.—Greenland: Upernavik, Disco Fjord, Godthaab-Julianehaab, S. E. coast, Scoresbysound, Franz Joseph Fjord, 1931–39. (M. H.)

Schaefferia sp., undescribed.—Arctic Alaska: Pt. Barrow, June 30, 1949, lemming runways on tundra. (N. A. W.)

ISOTOMIDAE

Folsomia diplophthalma Axelson.—Greenland: Thule Region, Upernavik, Kangerdlugssuaq, Scoresbysound, Franz Joseph Fjord, N. E. coast, 1931–39. (M. H.)

Folsomia fimetaria Linné.—Arctic Alaska: Pt. Barrow, June 30, 1949, lemming runways on tundra; Anaktuvuk Pass, July 6, 1949, humus at base of *Salix*. (N. A. W.); Greenland: Upernavik, Disco Fjord, Kangerdlugssuaq, Scoresbysound, Franz Joseph Fjord, N. E. corner, 1931-39. (M. H.)

This is a blind species, sometimes taken with *F. quadrioculata* but much less abundantly. It also occurs in north and central Europe. Stach took it in Poland under stones, in forest litter and moss as well as above timberline in moss and lichens.

Folsomia quadroculata Tullberg.—Arctic Alaska: Umiat, July 4, 1949, tundra, mostly of *Eriophorum*; Anaktuvuk Pass, July 7, 1949, humus at base of *Salix*; Fish Creek, lat. 70° 20′ N., long. 151° 30′ W., July 16, 1949, lemming nest (*Dicrostonyx rubricatus*) on windswept tundra; Oumalik, lat. 69° 50′ N., long. 156° 00′ W., July 15-16, 1949, tundra on bluff of lake. (N. A. W.) Arctic Canada: Arnprior, Ontario; October, 1917, Bernard Harbour, N. W. Territories, June 18, 1915, July 9, 1915. (C. A. E.) Greenland: Upernavik, Disco Fjord, Godthaab-Julianehaab, S. E. coast, Kangerdlugssuaq, Scoresbysound, Franz Joseph Fjord, N. E. coast, 1931-39. (M. H.)

This species is also found in Minnesota, Nova Zembla, Spitzbergen, White Island, Bear Island, Poland, Ukrainia, Bulgaria, Yugoslavia and is Holarctic generally. Stach took it commonly about human settlements and on mountain summits. He took it up to 2300 m. in Poland and it has been reported up to 2700 m. in the Swiss Alps. It occurs abundantly in forest litter and moss.

Folsomia sexoculata Tullberg.—Arctic Alaska: Pt. Barrow, June 30, 1949, lemming runways on tundra. (N. A. W.); Greenland: Disco Fjord, Godthaab-Julianehaab, S. E. coast, Kangerdlugssuaq, Scoresbysound, Franz Joseph Fjord, N. E. coast, 1931-39. (M. H.) This species is also found in Spitsbergen, 1921. (S. & S.), and in Finland, Scandinavia, Jan Mayen and North Germany (Stach).

Guthriella sp., undescribed.—Arctic Alaska: Pt. Barrow, June 28, 1949, lemming nest (*Dicrostonyx rubricatus*) on tundra. (N. A. W.)

Isotoma arborea Linné.—Greenland: Kangerdlugssuaq, 1931-39. (M. H.)

Isotoma bipunctata Axelson.—Greenland: Upernavik, Disco Fjord, S. E. coast, Kangerdlugssuaq, Scoresbysound, Franz Joseph Fjord, N. E. coast, 1931-39. (M. H.)

Isotoma cinerea Nicolet.—Greenland: Scoresbysound, 1931-39. (M. H.)

Isotoma coeruleo-griseus Hammer.—Greenland: Upernavik, Disco Fjord, Godthaab-Julianehaab, S. E. coast, 1931-39. (M. H.)

Isotoma finitima Stscherbakow.—Greenland: Franz Joseph Fjord Region, 1931-39. (M. H.) This species also found in British Isles, 1922.

Isotoma grandiceps Reuter.—Arctic Alaska: Anaktuvuk Pass, July 7, 1949, humus at base of *Salix*; Umiat, July 4, 1949, tundra, mostly of *Eriophorum*; Fish Creek, lat. 70° 20′ N., long. 151° 30′ W., July 16, 1949, lemming nest (*Dicrostonyx rubricatus*) on windswept tundra. (N. A. W.) A holarctic species.

Isotoma minor Schaffer.—Greenland: S. E. coast, Kangerdlugssuaq region, 1931-39. (M. H.)

Isotoma notabilis Schaffer.—Arctic Alaska: Anaktuvuk Pass, July 7, 1949, humus at base of *Salix*; Fish Creek, lat. 70° 20′ N., long. 151° 30′ W., July 16, 1949, lemming nest (*Dicrostonyx rubricatus*) on windswept tundra. (N. A. W.)

A European and possibly cosmopolitan species (Stach). He records it widely in Europe from many habitats but from no high altitudes.

Isotoma olivacea Tullberg.—Arctic Alaska: Umiat, July 4, 1949, tundra, mostly of *Eriophorum*; Pt. Barrow, July 13, 1949, census of lemming nest (*Dicrostonyx rubricatus*) on tundra; Fish Creek, lat. 70° 20′ N., long. 150° 30′ W., lemming nest (*Dicrostonyx rubricatus*) on windswept tundra;

Anaktuvuk Pass, July 7, 1949, humus at base of *Salix*. (N. A. W.) Greenland: Upernavik, Disco Fjord, Godthaab-Julianehaab, S. E. coast, Scoresbysound, Franz Joseph Fjord, N. E. coast, 1931-39. (M. H.)

A common species, especially in northern Europe (Stach) and probably holarctic. Stach records it from a variety of habitats, including under stones covered by snow.

Isotoma palustris Muller.—Arctic Alaska: Demarcation Pt., May 16, 1914, under driftwood. (C. A. E.); Arctic Canada: Bernard Harbour, N. W. Terr., May 25, 1916, June 9, 1915, on the surface of ponds. (C. A. E.) This species also found in the United States, Azores, India, Java, Siberia, Europe, Nova Zembla, Spitzbergen, and Bear Island.

Stach lists this under the genus *Isotomurus* Borner as a cosmopolitan species, being very common throughout Europe. It is usually found in wet places and is recorded up to 2430 m. on Polish mountains.

Isotoma violacea Tullberg.—Greenland: Upernavik, Disco Fjord, Godthaab-Julianehaab, S. E. coast, Franz Joseph Fjord, 1931-39. (M. H.)

Isotoma viridis Bourlet.—Arctic Alaska: Umiat, July 4, 1949, tundra, mostly of *Eriophorum* (N. A. W.); Anaktuvuk Pass, July 7, 1949, humus at base of *Salix* (N. A. W.); Fish Creek, lat. 70° 20′ N., long. 151° 30′ W., July 16, 1949, lemming nest (*Dicrostonyx rubricatus*) on wind-swept tundra (N. A. W.); Pt. Barrow, June 28, 1949, lemming nest (*Dicrostonyx rubricatus*) on tundra (N. A. W.); Collinson Pt., May 16, 1914, under driftwood logs on tundra; Demarcation Pt., September 27, 1913, under driftwood (C. A. E.); Arctic Canada: Bernard Harbour, N. W. Terr., May, 1915, under loose stones; Arnprior, Ont., March-April, 1915 (C. A. E.); Ellesmere Land (Stach). Greenland: Upernavik, Disco Fjord, Godthaab-Julianehaab, S. E. coast, Scoresbysound, Franz Joseph Fjord, 1931-39. (M. H.)

This species also found in Siberia, Spitzbergen, Bear Island, Iceland, and Europe. The color varies widely and many synonyms based on this character exist (Stach). It is a very common holarctic species found in a variety of biotopes and often on snow in Europe. It is not, however, everywhere a hardy species since it is not known beyond treeline in Poland. Stach records it in great numbers on snow in Poland at a temperature of 8° C. in January, moving quickly.

Isotoma sp.—Arctic Alaska: Oumalik, lat. 69° 50′ N., long. 156° 00′ W., July 16, 1949, tundra on bluff of lake; Fish Creek, lat. 70° 20′ N., long.

151° 30′ W., July 16, 1949, lemming nest (*Dicrostonyx rubricatus*) on wind-swept tundra. (N. A. W.)

Isotomurus paulustroides Folsom.—Arctic Alaska: Umiat, July 4, 1949, tundra of valley floor. (N. A. W.)

Recorded by Stach only from Ontario. He describes a geographical subspecies (*subicliatus*) from Ukrainia and Germany.

Priosotoma tenella Reuter.—Greenland: S. E. coast, Scoresbysound, 1931-39. (M. H.)

Pseudisotoma sensibilis (*Isotoma sensibilis*) Tullberg.—Arctic Alaska: Pt. Barrow, July 13, 1949, lemming nest (*Dicrostonyx rubricatus*) on tundra. (N. A. W.); Greenland: Upernavik, Godthaab-Julianehaab, S. E. coast, Kangerdlugssuaq, Scoresbysound, Franz Joseph Fjord, 1931-39. (M. H.)

Holarctic, and found in Swiss Alps to 3100 m. It is found " usually in moss, but also under loose bark of various trees, especially in lowlands; in the mountains it seeks shelter also in grass tufts and under stones " (Stach).

Tetracanthella wahlgreni Axelson.—Arctic Alaska: Pt. Barrow, July 13, 1949, lemming nest (*Dicrostonyx rubricatus*) on tundra. (N. A. W.) Arctic Canada: Bernard Harbour, N. W. Terr., June 18, 1915, on surface of pond. (C. A. E.); Greenland: Upernavik, Disco Fjord, Godthaab-Julianehaab, S. E. coast, Scoresbysound, 1931-39. (M. H.)

This species also found in Norway, Sweden, Finland, Spitzbergen, and Bear Island. Stach considers it circumpolar and found to the south in the Holarctic Region only in the mountains (Poland, Hungary, Spain); he considers it an endemic Arctic species carried south during the Pleistocene and left as a relic in the more southern areas. It is primarily a moss species.

NEELIDAE

Megatothorax minimus Willem.—Arctic Alaska: Fish Creek, lat. 70° 20′ N., long. 151° 30′ W., July 16, 1949, lemming nest (*Dicrostonyx rubricatus*) on wind-swept tundra; Oumalik, lat. 69° 50′ N., long. 156° 00′ W., July 15, 1949, tundra on bluff of lake. (N. A. W.)

ONYCHIURIDAE

Onychiurus armatus Tullberg.—Arctic Alaska: Umiat, July 4, 1949, tundra mostly of *Eriophorum*; Pt. Barrow, June 30, 1949, lemming runways on tundra; Fish Creek, lat. 70° 20′ N., long. 151° 30′ W., lemming nest (*Dicrostonyx rubricatus*) on wind-swept tundra; Oumalik, lat. 69° 50′ N., long. 156° 00′ W., July 15, 16, 1949, tundra on bluff of lake. (N. A. W.)

Greenland: Disco Fjord, Godthaab-Julianehaab, S. E. coast, Scoresbysound, Franz Joseph Fjord, 1931-39. (M. H.) This species also found in Bear Island, 1921, and in Spitzbergen, 1921.

Onychiurus duodecimpuncatus.—Arctic Canada: Bernard Harbour, N. W. Terr., May 19, 1915, in rotten driftwood in harbour. (C. A. E.)

Onychiurus groenlandicus Tullberg.—Greenland: Thule Region, Upernavik, Disco Fjord, Godthaab-Julianehaab, S. E. coast, Kangerdlugssuaq, Scoresbysound, Franz Joseph Fjord, N. E. coast, 1931-39. (M. H.)

Onychiurus pseudarmatus Folsom.—Greenland: Scoresbysound region, 1931-39. (M. H.)

Onychiurus sibiricus Tullberg.—Greenland: Franz Joseph Fjord region, 1931-39. (M. H.)

Onychiurus sp., undescribed (*sibiricus* group).—Arctic Alaska: Umiat, July 4, 1949, tundra mostly of *Eriophorum.* (N. A. W.)

PODURIDAE

Achorutes armatus Nicolet.—Arctic Canada: Arnprior, Ont., September, 1917. Bernard Harbour, N. W. Terr., May 25, 1916, June 18, 1915, on surface of ponds. Cockburn Pt., Dolphin Strait, Union Strait, N. W. Terr., July 15, 1916, moss in swamps. (C. A. E.) This species also found in Greenland, Spitzbergen, North Africa, Sumatra, Ceylon, New Zealand, Brazil, Uruguay, Chile, and the United States.

Achorutes muscorum Templeton.—Greenland: Godthaab-Julianehaab region, S. E. coast, 1931-39. (M. H.)

Achorutes sensilis.—Arctic Alaska: Pt. Barrow, August, 1948, in tundra. (N. A. W.) Arctic Canada: Bernard Harbour, N. W. Terr., July 5, 1916, on surface of pond. (C. A. E.)

Achorutes sp.—Arctic Alaska: Anaktuvuk Pass, July 9, 1949, valley floor. (N. A. W.)

Podura aquatica Linnaeus.—Arctic Alaska: Demarcation Pt., May 16, 1914. Arctic Canada: Arnprior, Ont., May 19, 1917; Bernard Harbour, N. W. Terr.; Dolphin and Union Straits, N. W. Terr., June 25, 1915, fresh-water ponds and streams. (C. A. E.) This species is also found in Europe and Siberia.

Xenylla humicola Fabricius.—Greenland: Upernavik, Disco Fjord, Godthaab-Julianehaab, S. E. coast, Franz Joseph Fjord, 1931-39. (M. H.) This species also found in Bear Island and Spitzbergen. (S. & E.)

SMINTHURIDAE

Arrhopalites binnoculatus Borner.—Arctic Alaska: Oumalik, lat. 69° 50′ N., long. 156° 00′ W., July 15, 16, 1949, tundra on bluff of lake. (N. A. W.)

Arrhopalites pygmaeus Wankel.—Greenland, S. E. coast, Scoresbysound, Franz Joseph Fjord, 1931-39. (M. H.)

Bourletiella sp.—Arctic Alaska: Oumalik, lat. 69° 50′ N., long. 155° 00′ W., July 16, 1949, tundra on bluff of lake. Anaktuvuk Pass, July 6, 1949, humus at base of *Salix*. (N. A. W.)

Sminthurides malmgreni Tullberg.—Greenland: Upernavik, Disco Fjord, S. E. coast, Scoresbysound, Franz Joseph Fjord, N. E. coast, 1931-39. (M. H.)

Sminthurides sp.—Arctic Alaska: Anaktuvuk Pass, July 7, 1949, from humus about lichens, mosses, and higher plants on fully exposed, jagged rocks facing the pass, altitude 3,950 feet. (N. A. W.)

Sminthurinus concolor Meinert.—Greenland: Upernavik, Disco Fjord, Godthaab-Julianehaab, S. E. coast, Kangerdlugssuaq, Scoresbysound, Franz Joseph Fjord, N. E. coast, 1931-39. (M. H.)

Sminthurinus niger Lubbock.—Greenland: Scoresbysound region, 1931-39. (M. H.) This species also found on Bear Island, 1921. (S. & E.)

Sminthurus aquaticus Bourlet.—Arctic Alaska: Oumalik, lat. 69° 50′ N., long. 156° 00′ W., July 15, 16, 1949, tundra on bluff of lake. (N. A. W.) Arctic Canada: Bernard Harbour, N. W. Terr., May 25, 1916, July 9, 1915, on surface of ponds. (C. A. E.) This species also found in Europe and the United States.

Sminthurus viridis Linné.—Arctic Alaska: Fish Creek, lat. 70° 20′ N., long. 151° 30′ W., July 16, 1949, lemming nest (*Dicrostonyx rubricatus*) on windswept tundra. (N. A. W).; Umiat, July 4, 1949, tundra mostly of *Eriophorum*. (N. A. W.); Greenland: Scoresbysound region, 1931-39. (M. H.)

Sphaeridia pumulis Krausbauer.—Arctic Alaska: Anaktuvuk Pass, July 6, 1949, humus at base of *Salix*. (N. A. W.)

Order PROTURA

(Proturans)

These primitive, rare and minute insects were not hitherto known from the Arctic and Ewing in his 1940 monograph on Protura of North America lists none from here. They were unexpectedly taken twice in 1949. At Anaktuvuk Pass at an elevation of 3950 feet they were found in humus about lichens, mosses, and higher plant roots on fully exposed jagged rocks facing the pass. From just below the summit of Umiat Mt. above the Colville River at an elevation of about 900 feet the insects were taken on the warmest exposure possible, the south side of the bluff, among humus. Both records are of *Acerentulus* sp. (Family Acerentomidae).

Order EPHEMEROPTERA

(Mayflies)

Mayflies were not taken on the Canadian Arctic Expedition in either Canada or Alaska and were not seen in 1948 following arrival in the Arctic after mid August. The adults, while with immatures one of the most important foods for fresh water fishes in temperate regions, are so fragile that life on the tundra would seem to be hazardous. They were, however, encountered in July 1949 in Anaktuvuk Pass as subimago females. The life of an average individual is extremely short and the emergence of all adults would appear to take place only at the height of the brief summer.

BAETIDAE

Baetis sp.—Alaska: Anaktuvuk Pass, July 6-8, 1949, at noon along stony creek. (N. A. W.)

Subimago females were occasionally seen on these days and individuals were seen as late as July 23. Members of this order were not reported by the Canadian Arctic Expedition and it is probable that their role as important food for fresh-water fishes in the Arctic is taken over by caddis flies and midges, young and adult. Burk (*personal communication*) believes that these insects overwinter in the Arctic in the egg stage and have an extremely short life in the nymph and adult stages. McDunnough reports mayflies from Baffin Land.

Order THYSANOPTERA

(Thrips)

Thrips are generally inconspicuous insects, noticed usually on flowers, and were not taken by the Canadian Arctic Expedition. Species of at least two genera were taken in the tundra from Pt. Barrow to Anaktuvuk Pass, several times in humus at the base of *Salix*, including *S. glauca* var. *acutifolia*.

Thrips sp.—Alaska: Pt. Barrow, September 1, 1948, males and females in the surface layer of tundra with a temperature of 36° F., the temperature at a depth of four centimeters being 32° F. and below this the ground being frozen; Anaktuvuk Pass, August 25, 30, 1948, on galls of *Salix* and in humus at base of *Salix*. (N. A. W.)

Aptinothrips sp.—Alaska: Anaktuvuk Pass, July 9, 1949, nymphs and adults on tundra of valley floor. (N. A. W.)

Unidentified thrips were taken at Oumalik, latitude 69° 50′ N., longitude 156° 00′ W., July 15, 1949, at base of *Salix glauca* var. *acutifolia* (Hook) and at Umiat, July 3, 1949, on top of valley. (N. A. W.)

Order ANOPLURA

(Sucking Lice)

Sucking lice were recorded in Alaska from the bearded seal and the Arctic fox, by the Canadian Arctic Expedition. The 1948 reconnaissance resulted in the discovery of these lice on the Pacific walrus at Pt. Barrow for the first time, of a genus different from that of the seal. The problem of transfer of such parasites from one animal to another is of particular interest since it would appear to be especially difficult on marine animals at low temperatures. In view of the significance of lemmings to several problems, the 1949 discovery of lice on them was a welcome addition to the biology of these animals. They were also taken on the ground squirrel, *Citellus parryi,* subspecies.

ECHINOPHTHIRIIDAE

Anatarctophthirius trichechi (Boheman).—Alaska: Pt. Barrow, August 20, 1948, off Pacific walrus, *Odobenus divergens* (Ill.). (N. A. W.)

Distribution.—Off *Odobenus rosmarus* (L) of Greenland and Spitzbergen.

Echinophthirius horridus (Olfers).—Alaska: Beaufort Sea, off bearded seal, *Phoca hispida* Schreber. (C. A. E.). A bearded seal at Pt. Barrow, July 27, 1949 was examined for lice and none was found. The Eskimos reported them to be free of external parasites.

Distribution.—Off *Phoca* spp. of Europe, Greenland, Alaska and California.

HAEMATOPINIDAE

Hoplopleura acanthopus (Burm.).—Alaska: Pt. Barrow, June 29, 1949, off tawny lemming, *Lemmus alascensis* Merriam. (N. A. W.) Mites were also present on the fur. Recorded by Ferris from *Lemmus alascensis* and "white lemming" (probably *Dicrostonyx rubricatus*) at Pt. Barrow.

Distribution.—Holarctic, off Muridae.

Linognathus setesus (Olfers).—Alaska: Cross Island, January 18, 1948, off Arctic fox, *Alopex lagopus innuitus* (Merriam). (C. A. E.)

Distribution.—Off domestic dog and coyote; widespread.

Neohaematopinus laeviusculus (Grube).—Alaska: Anaktuvuk Pass, off immature ground squirrels, *Citellus parryi* subspecies, July 28, 1949, brought to Pt. Barrow on July 8. (N. A. W.)

Distribution.—Holarctic, off Sciuridae, especially *Citellus* spp., *Cynomys, Marmota* and *Callospermophilus.*

Order ODONATA

(Dragonflies and Damselflies)

While not known from Arctic Alaska it is possible that stragglers could reach this area through Anaktuvuk Pass. Certainly the numerous swift streams, clear water and abundant food would seem to offer entirely suitable conditions.[2]

Order ORTHOPTERA

(Cockroaches, Grasshoppers and their allies)

Apparently grasshoppers occur rarely in this area, but the Canadian Arctic Expedition record is the only one to date. Even at McKinley Park and Fairbanks grasshoppers appear sparingly in what appear to be ideal habitats. They also would be expected to straggle through to the region through such places as Anaktuvuk Pass.

The occurrence of this order in the Arctic rests on a single female in poor condition of *Melanoplus frigidus* (Boheman) (Acrididae) from Langton Bay, Northwest Territories and on several specimens taken on the International Boundary (longitude 141° W., latitude 69° 20′ N. on August 8, 1912. (C. A. E.) Specimens of other insects taken with the same collection bore the label (lat. 59° 10′ N.–69° 40′ N., long. 141°), so that there is a possibility that the grasshoppers could have been taken farther south. The Langton Bay specimen was believed to have been brought with other insects by an Eskimo from 20 to 40 miles inland on the Horton River on the south side of the Melville Mountains, a range of hills about 1000 feet high. *Melanoplus frigidus* was also taken by me in Mt. McKinley Park, Alaska, August 4, 1949. It is a palearctic species known from " Norway, Lapland and Siberia, and as a glacial relict in the Swiss Alps and the Tyrol ". (Hebard, quoted by C. A. E.) The record of *Melanoplus m. mexicanus* (Sauss.) from Fairbanks, Alaska, September 7, 1948, was believed to be about a peripheral record for this species. (Weber, 1949, p. 121.)

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[2] Since the above was written, the prediction was strikingly verified July 8, 1950 at Umiat in latitude 69° 24′ N., far out on the Arctic Plateau, when three dragonflies were watched hawking at the margin of the vegetation about a pond on the floor of the Colville River Valley. The temperature had reached a high of 72° on this day and had been preceded by several days of unusually calm and warm weather. It is quite possible that these insects could have flown up from the Yukon drainage by way of such a pass as Anaktuvuk. Under the limited time and other conditions they were not captured but *Cordulia shurtleffi* Scudder, *Somatochlora albicincta* (Burmeister) and *S. hudsonica* (Hagen) have been recorded from Fort Yukon, roughly 260 miles southeast (Gloyd, 1939, Ent. News, 50: 11-16).

A male *Enallagma boreale* Selys (det. Dr. P. P. Calvert) was later (July 27) taken here by my assistant, David Trumper. The earlier specimens represented a larger and heavier species, probably of *Somatochlora.*

Order PLECOPTERA

(Stoneflies)

These are one of the most important foods for fresh-water fishes, but were not hitherto recorded from Arctic Alaska. Ten species were taken in 1948–49 and numerous specimens were taken from grayling and other fish stomachs.

PERLIDAE

Arcynopteryx americana Klapalek (*minor* Klapalek).—Alaska: Anaktuvuk Pass, July 9, 1949, under 15 cm. stone and alighting on me near river. (N. A. W.)

This large and dark species appeared to be much less abundant than *Nemoura trispinosa* here. Ricker (1944) records it in Alaska only from Mt. McKinley Park but also from Baffin Land, Mackenzie (latitude 64° 25′ N.), Keewatin (latitude 63° 01′ N.), and the western Canadian provinces. The species corresponds closely to the descriptions of the European *compacta.*

Alloperla diversa Frison.—Alaska: Anaktuvuk Pass, July 6-8, 22, 1949. (N. A. W.)

This species occurred with the mayfly, *Baetis,* along small stony creeks but was also taken at 4500 feet in the lee of a boulder on the north side of a precipitous mountain slope. This circumstance indicates the manner in which such insects could be carried by the wind from the Yukon drainage to the south through this broad pass. Not listed by Ricker from the Arctic or sub-Arctic but is considered (*in litteris*) a Cordilleran species.

CAPNIIDAE

Capnia confusa Claassen (*nivalis* Neave).—Alaska: Anaktuvuk Pass, July 6, 1949, along small stony creek at noon. (N. A. W.) Considered by Ricker (*in litteris*) to be a " Cordilleran species and not recorded hitherto from the North."

Capnia nearctica Banks.—Canada: Bernard Harbor, Northwest Terr., June 25, 1915. (C. A. E.)

Capnia nearctica - hantzschi group.—Alaska: Anaktuvuk Pass, July 9, 1949, resting close to the wind-swept sand of the Anaktuvuk River shore. (N. A. W.)

Capnia oenone Neave.—Alaska: Anaktuvuk Pass, August 26, 1948, males and females crawling on stem of dwarf *Salix* on island in stream and walking on snow with surface temperature of 29° F. (N. A. W.) Hitherto known only from southern British Columbia (Ricker).

NEMOURIDAE

Nemoura oregonensis Claassen.—Alaska: Anaktuvuk Pass, July 6, 1949, along small stony creek at noon. (N. A. W.) Considered by Ricker (*in litteris*) to be a Cordilleran species.

Nemoura trispinosa Claasen.—Alaska: Pt. Barrow, July 29-30, 1949; Anaktuvuk Pass, July 5-10, 1949, August 26, 1948. (N. A. W.) Other locality: Canada: Bernard Harbor, Northwest Terr., June 30, 1916 (as *Nemoura* sp.). (C. A. E.)

Considered by Ricker (*in litteris*) to be an Arctic-eastern species. Evidently the common species at Pt. Barrow where both adults and nymphs were taken on the above days. The tundra in the immediate vicinity of Pt. Barrow appears unsuitable, perhaps because of windiness or human intervention, but back several miles the insects are reared in the innumerable small ponds bordered by a comparatively lush growth of vegetation. At such a pond the chief grass was *Colpodium fulva* (det. Spetzman). At Anaktuvuk Pass the nymphs live at the margins of clear stony streams, taking refuge under the rocks. Adults flutter about the bushy margins.

Nemoura sp. A.—Alaska: Anaktuvuk Pass, July 6, 1949, along small, stony creek. (N. A. W.)

Nemoura sp. BB.—Alaska: Anaktuvuk Pass, July 5, 22, 1949. (N. A. W.)

Females of this species, which may be undescribed, were taken three times on the rugged mountain slopes at elevations of 2500–4550 feet (some 1300–2350 feet above the pass) where they must have been blown by the strong winds or fluttered up in stages. Two were attached to a small rock and another was clinging to the underside of a small rock at the summit (4550 feet) of a mountain. Mature nymphs of perhaps the same species were taken on the floor of the pass under a small (3–10 cm.) stone in an eddy of still water of an otherwise swift mountain stream. Over one hundred stones were overturned in finding five nymphs. One, placed in a rearing cage, emerged as an imago on the fourth day following.

Order MALLOPHAGA

(Bird Lice, Chewing Lice)

Most of the species are ectoparasites of birds. Since many birds come to the Arctic in the summer, a large list of Mallophaga could be compiled by listing the known kinds from these. The Arctic collectors of birds have not as a rule made much effort to collect the ectoparasites. Since most of the parasites leave the dead bird as soon as it chills, the opportunity to collect such insects is brief and the busy bird collector has little time for such searching.

Fourteen species of Mallophaga have now been identified from birds in Arctic Alaska, including the pomarine jaeger, snowy owl and snow bunting.

The family Trichodectidae, occurring only on mammals, was taken in 1948 from the Arctic weasel.

MENOPONIDAE

Myrsidea, or near.—Alaska: Pt. Barrow, August 23, 1948, nymph off Golden Plover. (N. A. W.)

Trinoton quarquedulae (L.).—Alaska: Barter Island, June, 1941, from pintail duck (*Dafila acuta* L.). (C. A. E.)

PHILOPTERIDAE

Anaticola sp.—Alaska: Pt. Barrow, July, 1949, of nymphs and adult male off Steller's eider duck. (N. A. W.)

Degeeriella complexiva Kell. and Chap.—Alaska: from *Tringa canutus* and *Tringa* (*Arquatella*) *couesi.* Other locality: Canada: Bernard Harbor, Northwest Terr., June, 1916, off Baird's sandpiper, *Pisobia* (*Actodromas*) *bairdi* (Coues). (C. A. E.)

Degeeriella normifer (Grube).—Alaska: Pt. Barrow, July 14, 1949, off male pomarine jaeger. (N. A. W.)

Degeeriella vulgata Kellogg.—Alaska: Demarcation Point, May, 1914, off Gambel's sparrow (*Zonotrichia leucophrys gambeli* (Nuttall)). (C. A. E.)

Ethiopterum modestum (Giebel).—Alaska: Pt. Barrow, July 14, 1949, off male and female pomarine jaeger. (N. A. W.)

Goniodes mammillatus Rudow.—Alaska: Demarcation Point, May, 1914, off rock ptarmigan (*Lagopus lagopus* (L.)). (C. A. E.) Other locality: Canada: Bernard Harbor, Northwest Terr., off rock and willow ptarmigans [*sic*] (*Lagopus rupestris* and *lagopus*). (C. A. E.)

Lipeurus protervus Kellogg.—Alaska: Demarcation Point, off rock and willow ptarmigans [*sic*] (*Lagopus rupestris* and *lagopus*) and from Lapland longspur (*Calcarius lapponicus*). Other locality: Canada: Bernard Harbor, Northwest Terr., off rock and willow ptarmigans. (C. A. E.)

Perineus laculatus (Kell. and Chap.).—Alaska: Pt. Barrow, July, 1949, off pomarine jaeger. (N. A. W.)

Philopterus ceblebrachys Nitzsch.—Alaska: Barter Island, June, 1914, Pt. Barrow, off snowy owl (*Nyctea nyctea* (L.)). (C. A. E.)

Philopterus cursor Nitzsch.—Alaska: Barter Island, Demarcation Point, May, 1914, from short-eared owl (*Asio flammeus* (Pont.), *A. accipitrinus* (Pall) [*sic*]. (C. A. E.)

Philopterus pustulosu Nitzsch.—Alaska: Camden Bay, June, 1914, off parasitic jaeger (*Stercorarius* (*Lestris*) *parasiticus* (L.)). (C. A. E.)

Philopterus subflavescens Geoff.—Alaska: Demarcation Point, off snow bunting (*Plectrophenax* (*Emberiza*) *nivalis* (L.) Lapland longspur (*Calcarius lapponicus* (L.) and Gambel's sparrow (*Zonotrichia leucophrys gambeli* (Nutt.)). (C. A. E.) Other locality: Canada: Bernard Harbor, Northwest Terr., off snow bunting. (C. A. E.)

TRICHODECTIDAE

A small family, unusual in occurring only on mammals.

Trichodectes mephitidis Osborn.—Alaska: Anaktuvuk Pass, August 27, 1948, off Arctic weasel, *Mustela a. arctica* (Merriam). (N. A. W.)

Trichodectes?—Record based on "a statement that a red fox, *Vulpes alascensis* (Merriam), taken along the Sadlerochit river, in northern Alaska, had a species of *Trichodectes* (?) in its fur. Unfortunately no specimens were preserved" (Baker, 1919, p. 5). (C. A. E.)

Order HETEROPTERA

(True Bugs)

Hemipterous bugs are not numerous in the Alaskan Arctic but *Chiloxanthus stellatus* (Curtis) appears widely distributed and well adapted. At Pt. Barrow the bugs prefer to jump rather than fly, and run under cover when pursued. The fact that *Anthocorus melanocerus* Reuter was taken *in copula* August 24 indicates that true bugs spend the first winter in the egg stage and nymphs taken September 13 indicate not only that they may overwinter also in this stage but that several summers are required to reach maturity. There is one record of water boatman (*Arctocoriza*) in the Alaskan Arctic and search should be made for others.

ANTHOCORIDAE

Anthocoris melanocerus Reuter.—Alaska: Umiat, August 24, 1948, a pair *in copula* in *Alnus* thicket; Anaktuvuk Pass, August 25, 1948, at base of *Salix*. (N. A. W.)

MIRIDAE

Chlamydatus sp., probably.—Alaska: Anaktuvuk Pass, July 10, 1949, nymph under stone. (N. A. W.)

Plagiognathus sp., possibly.—Alaska: Anaktuvuk Pass, July 10, 1949, nymph under stone. (N. A. W.)

SALDIDAE

Chiloxanthus stellatus (Curtis).—Alaska: Demarcation Point, May 16, 1914; west of Konganevik, Camden Bay, July 4, 1949; Collinson Point, September 13, 1913 (nymphs). (C. A. E.). Pt. Barrow, June 28, 1949 (nymph in lemming nest), June 30, 1949, on tundra. (N. A. W.) Other locality: Canada: mouth of Mackenzie River; Bernard Harbor, Northwest Terr., July 15, 1945 (adults) and June 20, 1916 (nymphs). (C. A. E.)

Calacanthia trybomi J. Sahlberg.—Alaska: Collinson Point, June 23, 1914. Other locality: Canada: Bernard Bay, Northwest Terr., June 19, 1915 (nymph). (C. A. E.)

CORIXIDAE

Arctocorixa sp.—Alaska: Teller, August 6, 1913. (C. A. E.)

Order Homoptera

(Aphids, Plant Lice, Coccids)

The soft bodied, juicy aphids and coccids would seem ill-suited to Arctic conditions yet they may be found at the bases of roots at Anaktuvuk Pass and on Umiat Mt. They feed on the sap of *Salix* roots and other plants.

A fragile-appearing cicadellid (*Balclutha* sp.) was taken as it burrowed into snow at a temperature of 28° F. Other fragile Homoptera (psyllids) of four or more species occur at least as far north as Umiat (69°) as do the more compact leafhoppers.

APHIDAE

Pemphigus sp.—Alaska: Anaktuvuk Pass, August 26, 1948, under small stones on roots of herbs on vegetation islands in stream bed. (N. A. W.)

Prociphilus sp., probably.—Alaska: Anaktuvuk Pass, August 26, 1948. (N. A. W.)

CICADELLIDAE

Balclutha sp.—Alaska: Anaktuvuk Pass, August 28, 1948, burrowing into snow patch at 5:45 p.m., the surface of the snow being 28° F., air temperature 32°. (N. A. W.)

Deltocephalus or related genus.—Alaska: Umiat Mt., 900 feet, July 11, 1949, on south slope of precipitous bluff. (N. A. W.)

COCCIDAE

Phenacoccus undescribed sp.—Alaska: Umiat Mt., 900 feet, July 11, 1949, on south slope of precipitous bluff. (N. A. W.)

Phenacoccus sp., possibly.—Alaska: Oumalik, latitude 69° 50′ N., longitude 156° 00′ W., nymphs from humus cover under thicket of *Salix glauca* var. *acutifolia* (Hook).

Pseudococcus sp., possibly undescribed.—Alaska: Anaktuvuk Pass, July 10, 1949, 3100 feet, from summit of mountain in humus about roots of *Salix*, *Potentilla*, grasses, etc.

Puto spp., including undescribed spp.—Alaska: Umiat, July 2-4, 1949, larvae on *Alnus*, females in dry and sunny spot 400 feet above Colville, and under *Alnus*, *Salix* and *Betula nana*; Oumalik, latitude 69° 50′ N., longitude 156° 00′ W., July 15, 1949, in humus under thicket of *Salix glauca* var. *acutifolia* (Hook); Anaktuvuk Pass, August 30, 1948, base of dwarf *Salix*, July 5, 1949, at 3200 feet; on southeast slope of mountain, July 6, 1949, larvae at base of *Salix Alexensis*, July 7, 1949, larvae at 3950 feet, in humus on talus slope. (N. A. W.)

JASSIDAE

Euscelis hyperboreus Van Duzee.—Alaska: west of Kongenevik, Camden Bay, June 27, 1914, male. Other locality: Canada: Bernard Harbor, Northwest Terr., July 15, 1915, female. (C. A. E.)

Euscelis sp.—Alaska: west of Kongenevik, Camden Bay, June 27, 1914. (C. A. E.)

PSYLLIDAE

Psylla alaskensis Ashm.—Alaska: Umiat, August 24, 1948, in *Alnus* thicket. (N. A. W.)

Psylla sp., near *alaskensis* Ashm.—Alaska: Anaktuvuk Pass, July 8, 1949, from sweeping over tundrae, 9 p.m. (N. A. W.)

Psylla sinuata Crawf.—Alaska: Anaktuvuk Pass, August 26, 1948. (N. A. W.)

Psylla sp.—Alaska: Umiat, July 4, 1949, from tundra material, mostly *Eriophorum.* (N. A. W.)

Trioza sp., near *varians* Crawf.—Alaska: Anaktuvuk Pass, August 28, 1948. (N. A. W.)

Order NEUROPTERA

(Lacewings, Aphis and Ant-lions)

Members of this order, *sensu strictu,* were not recorded by the Canadian Arctic Expedition but what was apparently an aphis-lion was taken at Anaktuvuk Pass on a *Salix* gall. In view of the proved presence of aphids here they should be expected but may well be scarce or local.

Order COLEOPTERA

(Beetles)

Beetles are not nearly as numerous in the Arctic as in temperate regions. Up to the present time about 50 species are known from the Alaskan Arctic. The most numerous beetles appear to be the carnivorous Carabidae, of which three or four species appear to be common. A noteworthy omission is the group of wood-inhabiting families including the Cerambycidae which are known from immediately south of tree line. The rover beetles or Staphylinidae are not uncommon and are involved in the lemming nest biome, perhaps preying on other insects and mites.

CANTHARIDAE

(Blister Beetles)

Cantharis sp.—Alaska: Umiat Mt., 900 feet, July 11, 1949. (N. A. W.)

CARABIDAE

(Carnivorous Ground Beetles)

Amara brunnipennis Dej.—Alaska: Nome, August 24-25, 1916; Kongonevick, Camden Bay, June 27, 1914; west of Collinson Point, June 12, 1914.

(C. A. E.) Other localities: Canada: Franklin Bay, Cockburn Point, Dolphin and Union Strait, September 7, 26, 1914; Bernard Harbor, May 18 to September 1, 1915-16; Kugalik River, Wollaston Peninsula, Victoria Island, August 18, 1915, all Northwest Terr. (C. A. E.)

Asaphidion (*Tachypus, auct.*).—Alaska: west of Collinson Point, June 12, 1914 (C. A. E.); Anaktuvuk Pass, July 9, 1949, on river sandbar. (N. A. W.)

Bembidium complanulum Mann.—Alaska: Nome, August 21-24, 1916. (C. A. E.)

Bembidium sp.—Alaska: Anaktuvuk Pass, July 9, 1949, on river sandbar. (N. A. W.)

Curtonotus sp.—Alaska: Anaktuvuk Pass, August 30, 1948. (N. A. W.)

Cryobius spp.—Alaska: Anaktuvuk Pass, August 28, 1948, July 5, 7, 9, 10, 22, 23, 1949 (to 3200, 3600, 3800 and 4000 feet). (N. A. W.)

Elaphrus riparius var. *gratiosus* Mann.—Alaska: Teller, July 31, 1913. (C. A. E.)

Elaphrus sp.—Alaska: Anaktuvuk Pass, July 9, 1949, on sandbar along Anaktuvuk River. (N. A. W.)

Notiophilus sp.—Alaska: Anaktuvuk Pass, 3200 feet, July 5, 1949; Oumalik, latitude 69° 50′ N., Longitude 156° 00′ W., July 15, 1949. (N. A. W.)

Nebria sp., near *bifaria*.—Alaska: Collinson Point, May 9, 1914. (C. A. E.)

Carabus truncaticollis Esch.—Alaska: Anaktuvuk Pass, June, 1949 (T. Brower); Oumalik, latitude 69° 50′ N., longitude 156° 00′ W., July 15, 1949, dying in tundra pond. (N. A. W.)

Carabus vietinghovi Adams.—Alaska: Umiat, top of valley, 750 feet, July 3, 1949. (N. A. W.)

Carabus chamissonis Fisch.—Alaska: Umiat, top of valley, 750 feet, July 3, 1949. (N. A. W.)

Pelophila eschscholtzii Mann.—Alaska: Teller, July 29, 1913. (C. A. E.)

Pterostichus (*Lyperophorus*) *agonus* Hom.—Alaska: Konganevick, Camden Bay, June 27, 1914; Collinson Point, September 27, 1913, June 1, 1914; Barter Island, June 11, 1914; Demarcation Point, May 20, 1914 (C. A. E.); Anaktuvuk, July 5, 1949. (N. A. W.) Other locality: Canada: Langton Bay, Franklin Bay, Northwest Terr. (C. A. E.)

Pterostichus mandibularis Kby.—Alaska: Konganevick, Camden Bay, June 27, 1914; Collinson Point, September 22, 27, 1913; Demarcation Point, May 6, 14-20, 1914. (C. A. E.) Other localities: Canada: Alaska border, Demarcation Point, Yukon, May 6, 1914; Cockburn Point, Dolphin and Union Strait, September 7, 1914; Bernard Harbor, June 15, 20, 1916, all Northwest Terr. (C. A. E.)

Pterostichus similis Men.—Alaska: Teller, July 24, 1913. (C. A. E.)

Pterostichus vindicatus Mann.—Alaska: Nome, August 21-24, 1916; Teller, July 24, 1913. (C. A. E.)

Unident. spp.—Alaska: Pt. Barrow, Anaktuvuk Pass, Umiat. (N. A. W.)

CHRYSOMELIDAE

(Ladybird Beetles)

Chrysomela subsulcata Mann.—Alaska: Konganevik, Camden Bay, June 27, July 4, 1914; Collinson Point, June 18, 1914, September 2, 1914, September 27, 1913. (C. A. E.); Pt. Barrow, July, 1950. (N. A. W.)

CURCULIONIDAE

(Weevils)

Apion sp.—Alaska: Umiat Mt., 900 feet, July 11, 1949, attacked by the red mite, *Leptus* sp. (Erythraeidae). (N. A. W.)

Lepidophorus lineaticollis Kby.—Alaska: Anaktuvuk Pass, August 25, 1948; in the vicinity of Eskimo racks of drying caribou meat in the open, July 7, 1949, 2600 feet, under rock on mountain slope in tangle of humus, roots and lichens. (N. A. W.)

DYTISCIDAE

(Water Beetles)

Agabus infuscatus Aube.—Alaska: Teller, July 29, 1913. (C. A. E.)

Agabus nigripalpis Sahlb.—Alaska: Teller, August, 1913; Collinson Point, September, 1913; Barter Island, July, 1914; Demarcation Point, May, 1914. (C. A. E.) Other localities: Canada: Bernard Harbor, May-August, Colville Mountains, Wollaston Peninsula, Victoria Island, July, 1914, Northwest Terr. (C. A. E.)

Agabus obsoletus Sec.—Alaska: Collinson Point, September, 1913. (C. A. E.)

Colymbetes dolobratus Payk.—Alaska: Teller, July, 1913. (C. A. E.) Other locality: Canada: Bernard Harbor, Northwest Terr., May-July. (C. A. E.)

Hydroporus humeralis Aube.—Alaska: Teller, August, 1913; Konganevik, Camden Bay, June, 1914; Demarcation Point, May, 1914. (C. A. E.) Other locality: Canada: Bernard Harbor, Northwest Terr., June-July. (C. A. E.)

Hydroporus tartaricus Lec.—Alaska: Collinson Point, September, 1913; Demarcation Point, May, 1914. (C. A. E.) Other locality: Bernard Harbor, Northwest Terr., May-August. (C. A. E.)

Hydroporus sp.—Alaska: Anaktuvuk Pass, August 26, 1948, in 39° F. pool beside river. (N. A. W.)

Tlybius angustior Gyll.—Alaska: Teller, August, 1913. (C. A. E.)

Unident. spp.—Alaska: Pt. Barrow, Anaktuvuk Pass. (N. A. W.)

ELATERIDAE

(Click Beetles)

Cryptohypnus sp. (probably *nocturnus* Esch.).—Alaska: Anaktuvuk Pass, August 25, 1948, larva. (N. A. W.)

Hypolittus sp., near *abbreviatus* Say but apparently new or palearctic.—Alaska: Umiat Mt., 900 feet, July 11, 1949. (N. A. W.)

Negastrius tumescens (Lec.).—Alaska: Umiat Mt., 900 feet, July 11, 1949. (N. A. W.)

SCYDMAENIDAE

Genus undetermined.—Alaska: Anaktuvuk Pass, July 9, 1949, tundra of mid-valley floor. (N. A. W.)

SILPHIDAE

(Carrion Beetles)

Thanatophilus lapponica Hbst. (=*Silpha lapponica* Hbst.).—Alaska: Konganevik, Camden Bay, July 4, 1914 (C. A. E.); Anaktuvuk Pass, August 30, 1948, July 5, 1949; Noluk L., Lat. 68° 47′ N., Long. 160° 0′ W., July 6, 1950, from dead caribou. (N. A. W.) Other localities: Canada: Port Epworth July 15, 1915, Kogluktualuk River, Coronation Gulf, July, 1915. (C. A. E.)

Thanatophilus trituberculata Kby.—Alaska: Anaktuvuk Pass, July 9, 1949, large black larva crawling over sandbar of Anaktuvuk River, emerging as imago July 25. (N. A. W.)

STAPHYLINIDAE

(Rove Beetles)

OMALIINAE

Unidentified larvae.—Alaska: Pt. Barrow, September 1-2, 1948, in tundra. (N. A. W.)

STAPHYLININAE

Micralymma brevilingue Schiodte.—Alaska: Pt. Barrow, September 1, 1948. (N. A. W.)

Tachinus apterus Maklin.—Alaska: Pt. Barrow, September 1, 1948, in tundra. (N. A. W.)

Unidentified spp.—Alaska: Pt. Barrow, June-August, 1949, larvae and adults in lemming nests. (N. A. W.)

TACHYPORINAE

Unidentified larvae.—Alaska: Pt. Barrow, August 20-23, 1948, in tundra. (N. A. W.)

Order TRICHOPTERA

(Caddis-flies, Caddis-worms)

The adults, known as caddis-flies, are among the hardiest Arctic insects and are widespread. The larvae are aquatic and form cases of woody material or grains of sand; they live in clear streams and lakes and are important food for fresh-water fishes.

LIMNEPHILIDAE

Anabolia emarginata Banks.—Alaska: Teller, July 29, 1913. (C. A. E.)

Grensia praeterita (Walk.).—Alaska: Anaktuvuk Pass, 1948, 1949, apparently the commonest species here; adults were taken to August 30 and larvae to August 26 in a pool with a black muck bottom at the tundra margin of a stream (31° F.) in the floor of the pass (N. A. W.); Meade River (L. Irving); Inaru River (Lat. 70° 54′, Long. 156° 37′) (L. Irving).

At the Inaru River Dr. Laurence Irving made the following observations on what were definitely determined as this species: " As I was fishing through the ice, about 10 inches thick, for grayling and walked up a small tributary stream near the Fish Camp, I noticed a fly on the ice, walking. It was like the Trichoptera, *Grensia praeterita* (Walk.) found on the snow on the 28th of September a year ago a little higher up the river and similar to those found earlier on the Meade River which the grayling were stuffed with.

" Looking further, I found a great many and in about 15 minutes picked up 30. They crawled actively, but did not move their wings. However, they were exploring with their long antennae and when I stood within about 5 feet of one, it walked toward me. If I moved around it followed. When I approached two which were diligently walking in the opposite direction, as I came within about 6 feet they turned and headed directly at me. These were all on ice, but on clear snow at the bank they did not seem attracted to me.

" The wind was about 20 miles from the East and only slightly screened by the banks two or three feet high. The stream was about 50 feet wide, the ice was rather smooth and on the lea side was a band of overflow about 10 to 20 feet wide. In general the direction of movement was downwind, and I watched to see if they crossed into the shelter of the tundra grasses. Quite a number approached the snow, which rose about 2 feet in 15 to the tundra with grass tips protruding, and there seemed confused, some going out onto the ice again and others following a long diagonal course. Only one that I watched made the incline in about 15 minutes of rather purposeful climbing until it reached a large cluster of protruding grass which it entered. It did not pass down the first scattered grass tips but persisted until a large tuft was reached.

" These flies were alert and crawled at a pretty good tempo although the air temperature was about – 3°. This day and the two preceding had been mild through the entire 72 hours, but not melting, and they had been preceded by two weeks hard freezing weather mostly from – 10° to 20°. While the sun had occasionally been bright it gave no warmth or melting, and so these flies had been exposed to at least two weeks of hard freezing weather with light snow cover. During that time lakes had frozen to 10 to 12 inches and even under the snow the ground was frozen 6 to 12 inches. In the morning the wind was somewhat stronger but still only a few degrees below freezing. I looked along the creek and found only one fly walking alertly over the ice.

" Since I saw no movement of the wings, I think that the flies were trapped by walking into the stream ice and collected there. They probably are come too late to this winged stage for survival or to leave any influence upon the future of their race, but still keep searching for whatever would be their usual occupation in life if opportunity were present for its pursuit."

Under the name of *Chilostigma praeterita* Walker this species is recorded from Canada: Bernard Harbour, Northwest Terr., September 23, 1915. (C. A. E.)

Limnephilus sp.—Alaska: Pt. Barrow, July 30, 1949, larvae in tundra pools about seven miles south southeast of the settlement. (N. A. W.) There were in addition larvae, pupae and adults of both sexes of *Micrasema scissum* in the same pools at the same time.

Limnephilus sp.—Alaska: Nome, August 21, 1916, female. (C. A. E.)

Pycnopsyche sp.—Alaska: Anaktuvuk, July 23, 1949, larvae in stomach of whitefish from Tolugak Lake. (V. Walters.)

Micrasema scissum McL.—Alaska: Head of Nanushuk River, lat. 68° 24′ N., long. 150° 30′ W., July 22, 1949, males and females flying on a calm, warm day (N. A. W.); Pt. Barrow, seven miles south southeast, July 29-30, 1949, larvae, pupae, males and females. (N. A. W.)

At the latter site the adults were hovering and fluttering about the small tundra pools which were partially filled with sphagnum moss; they also were resting among grasses and sedges at the margins of pools along with adult stoneflies, whose nymphs occurred in the same pools.

Radema arcticum Boh.—Alaska: Anaktuvuk Pass, July 23, 1949, female on meadow beside Tolugak Lake at 9:30 a. m. of a bright, warm and calm day (N. A. W.); Pt. Barrow, July 29, 1949, both on tundra back of camp and about seven miles south southeast (see *Limnephilus* and *Micrasema scissum*), hovering and fluttering about small tundra pools. (N. A. W.)

PHRYGANEIDAE

Banksiola sp.—Alaska: Pt. Barrow, July 29, 1949, females about tundra pools. (N. A. W.)

Order HYMENOPTERA

(Bees, Wasps and Ants)

The Hymenoptera of special interest and conspicuousness are the bumblebees, although the parasitic forms are much more numerous. To one accustomed to the sluggishness of insects at cool temperatures in the temperate or tropical regions it seems strange to see bumblebees active at near freezing temperatures. Their thick coat of hairs serves well to retain the heat of muscular activity as they buzz about the flowers. Seven species of *Bombus* are recorded.

One species of social wasp is known here; the wasps otherwise are solitary and parasitic. Among the wingless insects of the tundra are the ant-like *Myrmar* and *Gelis*. Sawflies (Tenthredinidae) are not uncommon and ten species are known. They are fed upon by fresh-water fishes as the opportunity occurs. Only two species of ants are definitely known from Arctic Alaska (*Leptothorax acervorum canadensis* and *Camponotus herculeanus*) both having a wide distribution through northern United States and in the Rocky Mountains farther south. They are holarctic or nearctic equivalent of palearctic species as is *Formica fusca* which will probably be found here.

TENTHREDINIDAE

(Sawflies)

Amauronematus aulatus MacG.—Alaska: Barter Island, June 16, 1914. (C. A. E.)

Amauronematus cognatus MacG.—Alaska: Demarcation Point, pupa May 14, imago June 23, 1914. (C. A. E.)

Amauronematus completus MacG.—Alaska: Collinson Point, June 20, 1914. (C. A. E.)

Amauronematus digestus MacG.—Alaska: West of Konganevik, Camden Bay, July 4, 1914. (C. A. E.)

Amauronematus indicatus MacG.—Alaska: West of Konganevik, Camden Bay, July 4, 1914. (C. A. E.)

Amauronematus varianus MacG.—Alaska: West of Konganevik, Camden Bay, June 27, 1914. (C. A. E.)

Enura sp.—Alaska: Anaktuvuk Pass, August 25, 1948, from gall of *Salix*. (N. A. W.); *E. abortiva* and *arctica* MacG. were described from the Canadian Arctic coast.

Rhogogastera reliqua MacG.—Alaska: Nome, August 21-25, 1916. (C. A. E.)

Urocerus flavicornis Fab.—Alaska: Nome. (C. A. E.)

Nematus sp.—Alaska: Collinson Point, November 29, 1913, pupa only. (C. A. E.)

BOMBIDAE

(Bumblebees)

Bombus arcticus. (Kirby).—Alaska: Collinson Point, July 10 and Barter Island, June 25, 1914. (C. A. E.) Other localities: Canada: Bernard Harbor, Cape Ross, Melville Island, Northwest Terr.; Herschel Island, Yukon Terr. (C. A. E.)

Bombus frigidus Smith.—Alaska: Nome, August 24-25, 1916. (C. A. E.)

Bombus kirbyellus (Curtis).—Alaska: Nome, August 24-25, 1916; Collinson Point, July 10, 1914. (C. A. E.) Other localities: Canada: Young Point, Fullerton, Northwest Terr. (C. A. E.)

Bombus moderatus Cr.—Alaska: Nome, August 24-25, 1916. (C. A. E.) Anaktuvuk Pass, August 27, 1948. (N. A. W.)

Bombus pleuralis (Nyl.).—Alaska: Nome, August 24-25, 1916. (C. A. E.)

Bombus polaris (Curtis).—Alaska: Nome, August 24-25, 1916; west of Collinson Point, June 11, 1914. (C. A. E.) Other localities: Canada: Kamarkok, west of Herschel Island, Yukon Terr. and Bernard Harbor, Northwest Terr., July, 1915-16. (C. A. E.)

Bombus sylvicola Kirby.—Alaska: Nome, August 24-25, 1916; Teller, July 26, 29, 1913; Barter Island, July 4, 1914; west of Collinson Point, June

11, 1914. (C. A. E.) Other localities: Canada: Herschel Island, Yukon Terr., end of July, 1916; Bernard Harbor, July 3, August 14, 1915; Port Epworth, Coronation Gulf, July 15, 1915, Northwest Terr. (C. A. E.)

Unidentified species.—Alaska: Anaktuvuk Pass, July 6-8, 1949; Umiat, July, 1949 (N. A. W.); Sadlerochit River, November 12, 1913 (dead pupae in nest). C. A. E.)

DIAPRIIDAE

(Parasitic Wasps)

Trichopria sp.—Alaska: Anaktuvuk Pass, July 8, 1949, trapped by insectivorous plant, *Pinguicula vulgaris.* (N. A. W.)

Xenotoma sp.—Alaska: Anaktuvuk Pass, August 26, 1948. (N. A. W.)

FORMICIDAE

(Ants)

Myrmica rubra L.?—Under the name of *Formica rubra* this ant was recorded from Parry's and Ross' voyages (see Johansen, 1921, p. 39).

Myrmica rubra is a common European species and the ants may well have been acquired by the ship or its cargo in a European port. It should not be considered a part of the American Arctic fauna on the basis of this record.

Leptothorax acervorum canadensis Prov.—Alaska: Umiat, June, 1948 (P. Scholander). Other locality: Canada: Reindeer Sta., Mackenzie Delta. (M. H.)

Camponotus herculeanus L.—Alaska: Anaktuvuk Pass, July 10, 1949, dealate female. (N. A. W.) Other localities: Canada: Reindeer Sta., Mackenzie Delta, July, 1948, workers and females (M. H.); Great Fish R., from Back's Overland Exped. (Children) (see Johanson, *loc. cit.*, p. 35).

The Anaktuvuk record of this characteristic wood ant is of particular interest in that the species has undoubtedly come through the pass from the spruce woods of the John River, a tributary of the Yukon. The Anaktuvuk site, on the Colville drainage, has large enough shrubs (of *Salix alexensis*) to permit the ants to become established at least during warm periods.

Formica fusca L.—Not taken in Arctic Alaska but recorded from Reindeer Sta., Mackenzie Delta (M. H.) and may turn up on the Alaskan side.

MYRMARIDAE

(Parasitic Wasps)

Myrmar sp.—Alaska: Umiat, July 4, 1949 in *Alnus* thicket, and Pt. Barrow, July 14, 1949, from lemming runway. (N. A.W.)

ICHNEUMONIDAE

(Parasitic Wasps)

Aptesis nivarius Brues.—Alaska: Collinson Point, June 20, 1914. (C. A. E.)

Aptesis sp.—Alaska: Anaktuvuk Pass, July 7, 1949, drowning in Tolugak Lake. (N. A. W.)

Atractodes sp.—Alaska: Anaktuvuk Pass, August 26, 1949. (N. A. W.)

Gelis sp.—Alaska: Anaktuvuk Pass, July 5, 3200 feet, under rock, and July 7, 3600 feet, also under rock, 1949. (N. A. W.) These ant-like and wingless insects occurred under rocks on the steep slopes in company with carabid beetles, spiders and in one case an aphid.

Stenomacrus brevipennis (Ash.).—Alaska: Pt. Barrow, August 20-21, 1948, among grass and herbs. (N. A. W.)

VESPIDAE

(Social Wasps)

Vespa norwegica albida Sladen.—Alaska: Nome, August 24-25, 1916; Teller, July 26, 1913 (as *Vespa marginata* Kirby) (C. A. E.); Anaktuvuk Pass, August 30, 1948, wasp nest with dead workers and females, several cells with honey and several with dead pupae; lower Chandler River, latitude 69° 10′ N., longitude 151° 35′ W., July 21, 1949, female flying over sunny river bank under *Populus balsamifera* L.; Umiat, July, 1949. (N. A. W.)

Order LEPIDOPTERA

(Butterflies and Moths)

Butterflies and moths may seem incongruous in the conventional view of the snowy tundra, yet they are common and widespread elements of the Alaskan Arctic. The familiar yellowish *Colias* of temperate regions is here, as are several reddish and brown spotted *Brenthis*. None of the butterflies and moths, however, are large and showy. The caterpillars are likely to be densely hairy and several seasons appear necessary for the life cycle. Eleven families of Lepidoptera are known from this region with Nymphalidae and Pieridae best represented.

EUCOSMIDAE

Eucosma sp.—Alaska: Nome, August 24, 1916; west of Konganevik, Camden Bay, end of June and July, 1914; Barter Island, June 27, July 11, 1914. Other locality: Canada: Bernard Harbor, Northwest Terr., July, 1915. (C. A. E.)

GEOMETRIDAE

Genus undetermined, 1.—Alaska: Oumalik, latitude 69° 50′ N., longitude 156° 00′ W., July 16, 1949, flying over tundra. (N. A. W.)

Genus undetermined, 2.—Alaska: Anaktuvuk Pass, July 23, 1949, flying over meadow beside lake, 9:30 A. M. (N. A. W.)

LYMANTRIIDAE

Byrdia sp.—Alaska: Anaktuvuk Pass, August 27, 1948, large, hairy caterpillar crawling sluggishly on tundra. (N. A. W.)

NOCTUIDAE

Barrovia fasciata Skin.—Alaska: Barter Island, July 11, 1914. (C. A. E.) Other locality: Canada: Herschel Island, Yukon Terr., July 29, 1916. (C. A. E.)

Lygris destinata Moesch.—Alaska: Nome, August 24-25, 1916. (C. A. E.) Other localities: Canada: Cape Pullen, Victoria Island, August 18, and Bernard Harbor, August 25, Northwest Terr. (C. A. E.)

NYMPHALIDAE

Brenthis alaskensis Holland.—Alaska: Barter Island, July 4, 11; Collinson Point, July 10; west of Konganevik, Camden Bay, July, all 1914 (C. A. E.); Anaktuvuk Pass, July 22-23, 1949. (N. A. W.)

At Barter Island the butterflies were reported flying on tundra in sunshine at a temperature of 50° F. and at Anaktuvuk Pass they were flying over a meadow at the lake shore at a somewhat higher temperature. Also at Anaktuvuk the butterflies were taken at 3800 feet, well up on the rugged mountains, and should easily be able to fly through this pass to or from the Yukon drainage to the south.

Brenthis arctica Zett.—Alaska: Anaktuvuk Pass, July 22, 1949, flying over meadow at 9:30 a. m. at the site of *alaskensis* above. (N. A. W.) A common and pretty species here.

Brenthis polaris Bdv.—Alaska: Barter Island, July 2-17, 1914. (C. A. E.) Other localities: Canada: Bernard Harbor, July 10-20, 1915 and July, 1916; southwest of Cape Krusenstern, July 3-4, 1916; Lake Angmaloktak, Wollaston Land, Victoria Island, July 29, 1915; Wollaston Land, summer 1915;

Port Epworth, Coronation Gulf, July 23, 30, 1915, all northwest Terr. (C. A. E.)

Brenthis chariclea Schneid.—Alaska: Collinson Point, July 10, 1914; Anaktuvuk Pass, July 3, 22, 23, 1949; Umiat, July 24, 1949. (N. A. W.) Other localities: Canada: Bernard Harbor, July 14, 1916, August 4, 6, 1915; Wollaston Land, Victoria Island, summer 1915; Port Epworth, Coronation Gulf, July 15, 1915, Armstrong Point, Victoria Island, July 1-10, 1916. (C. A. E.) This species also occurs more southerly in Canada and an Alaskan record bearing the label "lat. 59° 10′ N. to 69° 40′ N. and long. 141° (C. A. E.) may fall within Arctic Alaska.

Brenthis freija Thumb.—Alaska: Anaktuvuk Pass, July 6, 1949. (N. A. W.)

Brenthis fugga improba Butl.—Alaska: West of Konganevik, Camden Bay, July; Barter Island, July 1-5, 11, all 1914. (C. A. E.) Other localities: Canada: Bernard Harbor, July, 1916; Port Epworth, Coronation Gulf, July 15, 23, 1915, all Northwest Terr. (C. A. E.)

Polygonia zephyrus Edw.—Alaska: Specimens bearing the label " lat. 59° 30′ to 69° 40′ N., long. 141° " may have come from the Arctic. (C. A. E.)

OLETHREUTIDAE

Olethreutes sp.—Alaska: Anaktuvuk Pass, July 23, 1949, flying over meadow near lake shore, 9:30 a. m. (N. A. W.)

PHALAENIDAE

Genus undetermined, probably Agrotinae.—Alaska: Umiat, 750 feet, July 3, 1949, immatures. (N. A. W.)

Genus undetermined.—Alaska: Anaktuvuk Pass, August 22, 1948, July 9, 1949, larvae. (N. A. W.)

PIERIDAE

Colias, probably *palaeno*.—Alaska: Anaktuvuk Pass, July 22, 1949, flying at 3200 feet in mountain. (N. A. W.)

Colias pelidne Boisd and Le C.—Alaska: Anaktuvuk Pass, July 24, 1949. (N. A. W.)

Colias nastes alaskae B.—H.—Alaska: Umiat Mt., 950 feet, July 11, 1949. (N. A. W.)

Erebia rossii Curtis.—Alaska: Anaktuvuk Pass, July 23, 1949, flying over meadow at lake shore, 9:30 a. m. (N. A. W.) A large, dark butterfly not uncommon here.

Erebia disa streckeri Hall.—Alaska: Umiat Mt., 950 feet, July 11, 1949. (N. A. W.)

Eurymus hecla glacialis McLoch.—Alaska: Collinson Point, July 10; Barter Island, July 4-21, 1914. (C. A. E.) Other localities: Canada: Herschel Island, Yukon Terr. end of July, 1916; Bernard Harbor, Northwest Terr., July 14, August 4-25, 1915. (C. A. E.)

Eurymus palaeno chippewa Edw.—Alaska: Nome, August 24-25, 1916. (C. A. E.)

Eurymus nastes Bdv.—Alaska: Collinson Point, July 10, 17; Barter Island, July 17, all 1914. (C. A. E.) Other localities: Cockburn Point, Dolphin and Union Strait, September 2, 1915; Bernard Harbor, July 30, August 1-25, 1915, July 14, 1916; Armstrong Point, Victoria Island, early July, 1916, all Northwest Terr. (C.A. E.)

PYRALIDAE

Diasemia alaskanis Gibson.—Alaska: Collinson Point, July 10, and Konganevik, Camden Bay, early July, 1914. (C. A. E.)

Pyla arctiella Gibson.—Alaska: Collinson Point, July 17, 1914. (C. A. E.)

SATYRIDAE

Oeneis taygete hanburyi Wats.—Alaska; Anaktuvuk Pass, July 6, 22, 1949, 3200 feet on mountain. (N. A. W.)

TORTRICIDAE

Sparganothe ?.—Anaktuvuk Pass, July 22-23, 1949, flying over meadow at lake shore, 9:30 a. m., and at 3200 feet on mountain. (N. A. W.)

DIPTERA

(Flies)

Two-winged flies are easily the most numerous of the obvious insects in the Arctic. Mosquitoes in Arctic and sub-Arctic regions are notoriously bad and occur in incredible swarms. Only in a marsh in temperate zones do the numbers approximate those arising from the innumerable tundra pools. Nothing like these numbers have been encountered by the author in the tropics although the upper Orinoco Delta, Venezuela, is sufficiently bad so that the Indians regularly move out at the time of their largest numbers, which comes during the dry season. Fortunately the Arctic Alaskan mosquitoes are not known to carry malaria. They are nevertheless important pests of caribou and Dall's sheep, as well as of Eskimos. Possibly the females usually acquire their blood meals from shore and aquatic birds.

While mosquitoes are the notorious insects, there is a great variety of midges which may well have a greater general biological importance. The larvae are scavengers and important agents in the first step in converting dead or living vegetation into more complex foods. They serve as food for fishes and other animals, aquatic or terrestrial, as do the adults. Many of the midges belong to the family Tendipedidae, also known as Chironomidae.

In addition to mosquitoes and midges there are numerous blowflies and a botfly of some importance to the Eskimos through its infestation ruining the skins of caribou. Many other types of flies are represented as may be seen below. The common house fly has yet to reach Pt. Barrow although conditions now may be suitable and it may be merely a question of time.

Order DIPTERA

Suborder NEMATOCERA

TIPULIDAE

Dicranomyia alascaensis Alexander.—Alaska: Nome, August 24-25, 1916. (C. A. E.)

Poecilostola ?.—Alaska: Demarcation Point, May, 1914. (C. A. E.) One large larva taken in melted pond on tundra.

Stygeropis parrii (Kirby).—Alaska: West of Kongenevik, Camden Bay, July 4, Collinson Point, June 22-23, 1914, also possibly Demarcation Point, May. (C. A. E.) Other locality: Bernard Harbor, Northwest Terr., July 1-14, 1916, July-August, 1915. (C. E. A.)

Tipula bergrothiana Alexander.—Alaska: Anaktuvuk Pass, July 10, 1949, flying over tundra. (N. A. W.)

Tipula sp.—Alaska: Anaktuvuk, July 8, 1949, larvae from margin of stream bed; July 10, 1949, larva on summit of 900 foot mountain (elev. 3100 feet above sea level) in moist black humus at roots of *Salix*, *Potentilla*, grasses, etc.; August 25-30, 1948, larvae. (N. A. W.)

Tipulidae sp.—Alaska: Umiat Mt., 900 feet, July 11, 1949. (N. A. W.)

Tipulini.—Alaska: Nome, August, 1916, larvae; Demarcation Point, May, 1914, larvae in melted ponds on tundra. (C. A. E.)

Tricyphona brevifurcata Alexander.—Alaska: west of Konganevik, Camden Bay, July 4, 1914, male. (C. A. E.)

TENDIPEDIDAE

(Chironomidae)

DIAMESINAE

Diamesa sp.—Alaska: Anaktuvuk Pass, August 29-30, 1948, walking on snow. (N. A. W.)

HYDROBAENINAE

Unident sp.—Alaska: Pt. Barrow, July 13, 1949, from yellow flower; Oumalik, latitude 69° 50′ N., longitude 156° 00′ W., July 15, 1949, from sweepings over tundra; Anaktuvuk Pass, July 10, 1949, from vegetation on summit of 900-foot mountain (elev. 3100 feet above sea) and at same place, from blue flower of shooting star, *Dodecatron frigidus*. (N. A. W.)

ORTHOCLADIINAE

Cricotopus sp.—Alaska: Oumalik, latitude 69° 50′ N., longitude 156° 00′ W., July 15, 1949, from sweeping over tundra. (N. A. W.)

Orthocladius, sp. 1.—Alaska: Collinson Point, June 22-23, 1914. (C. A. E.)

Orthocladius, sp. 2.—Alaska: Demarcation Point, May 16, 1914, in mud of freshwater ponds. (C. A. E.)

Spaniotoma spp.—Possibly including the two species listed as *Orthocladius* above and consisting of a number of species. Probably the most numerous winged insect of the tundra about Pt. Barrow and perhaps of the Alaskan tundra generally. Alaska: Pt. Barrow, August 20-22, September 2, 1948, July 14, 1949; Anaktuvuk Pass, August 26-20, 1948; Fish Creek, latitude 70° 20′ N., longitude 151° 30′ W., July 16, 1949, from sweeping over exposed tundra in high, cold wind. (N. A. W.)

Numerous other collections made at other times and places doubtless include this genus. A complex group for the dipterologist and one in considerable need of study.

Spaniotoma is deeply involved in the tundra life. The larvae are reared in a variety of media including regurgitated pellets of the snowy owl, the humus or sand about the clumps of beach plants and others back in the tundra. They also live in inland black-bottomed pools, where they actively wriggle about, and occur in great numbers in the nests of lemmings, dominant vertebrates of the tundra. At the very northern tip of Alaska, the Pt. Barrow sandspit, larvae were taken at the bases of *Salix*, *Saxifraga groenlandica*, *S. hirculus* and other plants in a habitat characterized by my companion, Dr. Scholander, as typical Arctic tundra, more so than the general Arctic coast region of Alaska. Larvae are well adapted to low temperatures and may " loop " over the wet tundra at near freezing temperatures with patches of snow in the immediate vicinity. Larvae from a lemming nest taken into the laboratory pupated and emerged as imagoes on the eleventh and successive days. Adults alight and walk freely about on snow at slightly below freezing temperatures. They also alight freely on pools where they do not perceptibly depress the surface film. During the frequent winds of the coastal area the adults stay close to the ground among the low plants.

PELOPIINAE

Unident sp.—Alaska: Oumalik, latitude 69° 50′ N., longitude 156° 00′ W., July 15, 1949, from sweeping over tundra; Fish Creek, latitude 70° 20′ N., longitude 151° 30′ W., July 16, 1949, from sweepings over low tundra in high wind. (N. A. W.)

TENDIPEDINAE

Tendipes sp.—Alaska: Fish Creek, latitude 70° 20′ N., longitude 151° 30′ W., July 16, 1949, from sweepings over low tundra in high wind. (N. A. W.)

Chironomus, sp. 1.—Alaska: Barter Island, July 2, 1914. (C. A. E.)

Chironomus, sp. 2.—Alaska: Collinson Point, June 22, 1914, from pool. (C. A. E.)

This and the preceding species may possibly belong to what is now called *Tendipes*.

Unidentified spp.—Alaska: Pt. Barrow, July 14, 1949, from sweepings over yellow flowers and sedges; Oumalik, latitude 69° 50′ N., longitude 156° 00′ W., July 16, 1949, from surface of tundra pool; Fish Creek, latitude 70° 20′ N., longitude 151° 30′ W., July 16, 1949, from sweepings over low tundra in high wind; Anaktuvuk Pass, July 8, 1949, larvae from margin of stream bed. (N. A. W.)

HELEIDAE

(Ceratopogonidae)

Dasyhelea sp.—Alaska: Oumalik, latitude 69° 50′ N., longitude 156° 00′ W., July 15, 1949, from sweepings over tundra and from surface of pool. (N. A. W.)

Helea sp.—Alaska: Anaktuvuk Pass, July 5, 1949, 2500 feet, in humus on rocky slope. (N. A. W.)

MELUSINIDAE

Melusina sp.—Alaska: Anaktuvuk Pass, July 6, 1949, larvae in humus under *Salix alexensis* near creek; Pt. Barrow, August 21, 1948, under wood. (N. A. W.)

SIMULIIDAE

Simulium arcticum Mall.—Alaska: Anaktuvuk Pass, August 27, 1948, becoming nuisance at lake shore at noon. (N. A. W.)

CULICIDAE

Aedes communis (De Geer).—Alaska: Umiat, May-August, 1947. (Jackowski and Schultz)

Aedes nearcticus Dyar.—Alaska: Oumalik, latitude 69° 50′ N., longitude 156° 00′ W., July 16, 1949, from surface of tundra pool (N. A. W.); Umiat, May-August, 1947 (Jackowski and Schultz)

Aedes nigripes (Zett.).—Alaska: Fish Creek, latitude 70° 20′ N., longitude 151° 30′ W., July 16, 1949, from sweepings over low tundra in cold, high wind (N. A. W.): Umiat, May-August, 1947. (Jackowski and Schultz)

Aedes punctor (Kirby).—Alaska: Umiat, May-August, 1947. (Jackowski and Schultz)

Aedes spp.—Alaska: localities of the *Aedes* species above; Umiat, July 2, 1949, 8 p. m. (N. A. W.)

Swarms of unidentified mosquitoes, doubtless of this genus, were encountered in numerous localities during July, 1949. Low temperatures and high winds kept them down at Umiat until July 4. The day of my arrival at Anaktuvuk Pass on July 5 was the first day the Eskimos reported that they were at all pestered by mosquitoes, because of the coolness of the season. Their numbers rapidly increased, with great swarms in sheltered places exceeding in numbers those in the tropics. At temperatures of 55°–60° F. in the evening, when the sun did not set during the night, they remained active and pestiferous but at temperatures below 50° they became sluggish, and at temperatures from 40°–45° F. they did not fly about. Apparently their chief breeding places were the tiny pools on the tundra. They ascended the heights of the Brooks Range and were extremely numerous on July 22 at over 4500 feet wherever they found shelter in the lee of the rugged slopes. Caribou, Dall's sheep and other mammals seek refuge on the most exposed slopes to escape the hordes. It is probable that the mosquitoes ascend to at least 5000–6000 feet here. Spiders form webs between the jagged rocks and catch large numbers on the mountain slopes.

FUNGIVORIDAE

(Sciophilidae, Sciaridae)

Boletina sp.—Alaska: Oumalik, latitude 69° 50′ N., longitude 156° 00′ W., July 16, 1949, from surface of tundra pool; Umiat, August 24, 1948, in *Alnus* thicket. (N. A. W.)

Bradysia sp.—Alaska: Umiat, July 3, 1949, inside quonset sleeping quarters 8 a.m.; Anaktuvuk Pass, July 8, 1949, trapped by insectivorous plant, *Pinguicula vulgaris*, July 5, 1949, 2,500 feet, on rock. (N. A. W.)

Lycoria sp.—Alaska: Pt. Barrow, August 21-23, 1948, larvae under wood on tundra and adults at inside of laboratory window 3:15 p.m.; Umiat, August 24, 1948, adults in *Alnus* thicket; Anaktuvuk Pass, August 25-26, 1948, adults, larvae July 6, 1949 in humus under *Salix alexensis* beside creek (N. A. W.) A common midge. Also Teller and Nome (as *Sciara*). (C. A. E.)

Phronia sp.—Alaska: Anaktuvuk Pass, August 25, 1948, flying in lee of river bank in low 40°'s F. (N. A. W.)

Rhymosia sp.—Alaska: Anaktuvuk, August 28, 1948, midge floating on pool. (N. A. W.)

ITONIDIDAE

Unidentified sp.?—Alaska: Anaktuvuk Pass, July 8, 1949, larvae from margin of stream bed. (N. A. W.)

LARVAEVORIDAE

(Tachinidae)

Genus and species?, near *Alaskophyto*.—Alaska: Anaktuvuk Pass, August 27, 1948.

Euphorocera gelida Coquillett.—Alaska: Camden Bay, Demarcation Point, June-July, 1914. (C. A. E.)

BIBIONIDAE

Bibio sp.—Alaska: Anaktuvuk Pass, August 28, 1948. (N. A. W.)

SCATOPSIDAE

Scatopse sp.—Alaska: Anaktuvuk Pass, July 8, 1949, from humus of stream bed and from entrance to burrow of *Citellus parryi*. (N. A. W.)

Suborder ORTHORRHAPHA

TABANIDAE

Tabanus (*Hybomitra*) *frontalis septentrionalis* Loew.—Alaska: Head of Nanushuk River, latitude 68° 24′ N., longitude 150° 30′ W., July 22; Anaktuvuk Pass July 23, and Umiat, August 2, all in 1949. (N. A. W.) Evidently having a very short season as adults in these latitudes of scarcely more than a month.

Tabanus (*Hybomitra*) *boreus* Stone.—Alaska: 69° 10′ N., 141° W. (Stone.)

Tabanus (*Hybomitra*) *sexfasciatus* Hine.—Alaska: Umiat, July 5, 8, 1950. (N. A. W.)

EMPIDIDAE

Bicellaria pilipes Loew.—Alaska: Anaktuvuk Pass, August 26, 1948. (N. A. W.)

Empis sp.—Alaska: Umiat Mountain, 950 feet, July 11, 1949, attacked by spider; Oumalik, latitude 69° 50′ N., longitude 156° 00′ W., July 15-16, 1949, from sweepings over tundra. (N. A. W.)

Rhamphomyia erinacioides Malloch.—Alaska: West of Kongenevik, Camden Bay, July 4; Barter Island, July 11, 1914. (C. A. E.)

Rhamphomyia sp.—Alaska: Anaktuvuk Pass, 2500 feet, July 5, 1949, on rocky slope. (N. A. W.)

DOLICHOPODIDAE

Dolichopus sp.—Alaska: Nome, August 21, 1916. (C. A. E.)

Hydrophorus pilitarsis Malloch.—Alaska: Teller, July 29, August 6, 1913. (C. A. E.)

Hydrophorus signiferus Coquillett.—Alaska: Teller, July 29, August 6, 1913. (C. A. E.)

Hydrophorus innotatus Loew.—Alaska: Collinson Point, June 20, 1914. Other locality: Canada: Bernard Harbor, Northwest Terr., June, 1915. (C. A. E.)

Suborder CYCLORRAPHA

PHORIDAE

Apiochaeta alaskensis Malloch.—Alaska: Nome, August 24-25, 1916. (C. A. E.)

Apiochaeta platychira Malloch.—Alaska: Nome, August 21-25, 1916. (C. A. E.)

Apiochaeta sp.—Alaska: Nome, August 24-25, 1916. (C. A. E.)

Megaselia dubitata Malloch.—Alaska: Anaktuvuk Pass, August 26, 1948. (N. A. W.)

SYRPHIDAE

Helophilus dychei Williston.—Alaska: Nome, August 24-25, 1916. Other locality: Canada: Bernard Harbor, Northwest Terr., July 6, 1916; on *Dryas* flower. (C. A. E.)

Metasyrphus sp.—Alaska: Anaktuvuk Pass, July 6, 1949, larvae in humus under *Salix alexenesis* beside creek. (N. A. W.)

Scaeva pyrastri L.—Alaska: Barter Island, June 10, 1914. (C. A. E.)

Syrphus sp.—Alaska: Anaktuvuk Pass, July 9, 1949, sweepings along edge of creek in strong wind. (N. A. W.)

SARCOPHAGIDAE

Sarcophaga sp.—Alaska: Pt. Barrow, July 13, 1949, larvae and pupae from lemming carcass (*Dicrostonyx rubricatus*) found on tundra. (N. A. W.)

SCATOPHAGIDAE

(Scopeumatidae)

Dasypleuron tibialis Malloch.—Alaska: Collinson Point, June 20, 1914. (C. A. E.)

Scatophaga furcata (Saz).—Alaska: Nome, August 21-25, 1916; Barter Island, June 8, July 2, 1914; Collinson Point, June 15, 1914. (C. A. E.) Other locality: Canada: Wollaston Peninsula, Victoria Island, August 18, 1915. (C. A. E.)

Scatophaga suilla (Fabr.).—Alaska: Nome, August 21, 1916. (C. A. E.)

Scopeuma (formerly *Scatophaga*) *vulpinum* (Coquillet).—Alaska: Pt. Barrow, July 13, 1949. (N. A. W.)

A seething mass of larvae emerged from what was apparently a shotgun wound in the side of an Eskimo dog carcass which had perhaps lain on the tundra about a week. Large and small larvae were scattered in the fur; the air temperature was in the low 40's F. The rich-brown, hairy adults were slow-moving in the cold and many had defective wings. Several attempted copulation, but mostly they fell from the fur to the ground and crawled sluggishly back to the carcass. An Eskimo with me knew about the flies as infecting meat. On the same day a water-soaked lemming nest was examined which contained a decomposing adult (*Dicrostonyx rubricatus*). Several hundred larvae emerged from the carcass when it was brought into the laboratory, as did several adults.

Scopeuma lanatum (Lund.).—Alaska: Anaktuvuk Pass, July 5, 1949, 10 p. m. in bright sun. (N. A. W.)

Scopeuma nubiferum (Coq.).—Alaska: Pt. Barrow, August 22, 1949, dead on pool. (N. A. W.)

Undetermined sp.—Alaska: Anaktuvuk Pass, August 30, 1949, larvae. (N. A. W.)

CALLIPHORIDAE

Boreelus atriceps Zett.—Alaska: Pt. Barrow, August 22, 1948. (N. A. W.) Puparia from carcass of Eskimo dog, on tundra near coast, from which imagoes emerged August 31, in the laboratory, and September 1-2. (N. A. W.)

Calliphora viridescens Rob.-Desv.—Alaska: Nome, June 21, 1916. (C. A. E.)

Cynomyopsis cadaverina (R. D.).—Alaska: Pt. Barrow, August 22, 1948, from Eskimo dog carcass (N. A. W.); Barter Island, June 15, 20, 23, July 2, 1914, west of Konganevik, Camden Bay, June 4, 1914; Nome, August 24-25, 1916. (C. A. E.)

Lucillia illustris (Mg.) ?.—Alaska: Pt. Barrow, July 13, 1949, from Eskimo dog carcass of *Scopeuma vulpinum* above. (N. A. W.)

Phoenicia sp.—Alaska: Pt. Barrow, August 22, 1948, from Eskimo dog carcass of *Boreëlus atriceps* above. (N. A. W.)

Phormia terrae-novae Rob.-Desv.—Alaska: Nome, August 24-25, 1916; Teller, July-August, 1913; Collinson Point, June, 1914; Demarcation Point, May 13, 1914. (C. A. E.) Oumalik, latitude 69° 50′ N., longitude 156° 00′ W., July 15, 1949, puparia under board from which imagoes emerged by July 25. (N. A. W.) Other locality: Canada: Bernard Harbor, Northwest Terr., June-August, 1915, June-July, 1916. (C. A. E.)

Genus and species undetermined.—Alaska: Anaktuvuk, 1948.

MUSCIDAE

Alliopsis obesa Mall.—Alaska: Anaktuvuk, alighting twice momentarily on snow bank, August, 1948. (N. A. W.)

Alliopsis sp.—Alaska: Camden Bay, June, 1914. (C. A. E.)

Hylemyia acrostichalis Malloch.—Alaska: Nome, August 21, 1916. (C. A. E.)

Hylemia variata (Fallen).—Alaska: Nome, August 24-25, 1916. (C. A. E.)

ANTHOMYIDAE

Egle radicum (L.).—Alaska: Nome, August 21, 24-25, 1916; Teller, July 29, 1913. (C. A. E.)

Pegomyia albimargo Pandell.—Alaska: Nome, August 21-24, 1916. (C. A. E.)

Pegomyia flavipes (Fallen).—Alaska: Nome, August 21, 1916. (C. A. E.)

Phorbia brevitarsata Malloch.—Alaska: west of Konganevik, Camden Bay, June, July 4, 1914. (C. A. E.)

Phorbia spp.—Alaska: Collinson Point, June 20, 1914. (C. A. E.)

Phaonia minima Malloch.—Alaska: Nome, August 21-24, 25, 1916. (C. A. E.) Other locality: Canada: Bernard Harbor, Northwest Territory, May 19, 1916; May 20, 22, June 25, July 11, 1915. (C. A. E.)

PIOPHILIDAE

? (*Allopiophila*) sp.—" Possibly a new genus and new species. It seems near *A. aterrima* (Becker) described from Novaya Zemlya".—Alaska: Pt. Barrow, larvae in turfy tundra August 22, and appearing from beneath carcass of small duck September 2, 1948, at top of sandspit of the point.

Beneath the duck the ground was covered with frost crystals and larvae were here contracted and immobile. Imagoes appeared 24 hours later from the carcass in the laboratory. (N. A. W.)

HELEOMYZIDAE

Neolaria rotundicornis Malloch.—Alaska: Nome, August 24-25, 1916. (C. A. E.)

Neolaria tibialis (Zett.), at least in sense of authors.—Alaska: Anaktuvuk, August, 1948. (N. A. W.)

Neolaria sp.—Alaska: Pt. Barrow, August 22, 1948, adults under Eskimo dog carcass described under *Phaenicia* above; sluggish in the near-freezing temperature, ice and snow on the tundra not thawing. (N. A. W.)

Oecothea aristata Malloch.—Alaska: Anaktuvuk Pass, August, 1948. (N. A. W.)

AGROMYZIDAE

Agromyza immaculata Coq.—Alaska: Anaktuvuk Pass, August 25, 1948, flying in lee of river bank. (N. A. W.)

CHLOROPIDAE

Botanobia (*Oscinis*) *frit* (L.).—Alaska: west of Konganevik, Camden Bay, July 4, 1914. (C. A. E.)

EPHYDRIDAE

Scatella brunnipennis Malloch.—Alaska: Demarcation Point, May 16; Collinson Point, June 20, 1914, September 22, 1913. (C. A. E.) Other locality: Canada: Bernard Harbor, Northwest Terr., July, 1915. (C. A. E.)

SPHAEROCERATIDAE

(Borboridae)

Copromyza sp.—Alaska: Pt. Barrow, September 5, 1948 and earlier; appearing in the mess hall sparingly with *Leptocera fontinalis* below, and under Eskimo dog carcass of *Phoenicia et al.* above. (N. A. W.)

Leptocera fontinalis (Fall).—Alaska: Pt. Barrow, September 5, 1948 and earlier; appearing in the mess hall sparingly at the dining tables and found dead in numbers in a 30-gal. can of cornmeal in the storeroom. Not a pest and reported to be present only in 1948. Not seen June-August, 1949. (N. A. W.)

Order SIPHONAPTERA

(Fleas)

Fleas, these small, wingless and laterally compressed insects, are mammalian ectoparasites which are not common in the Arctic, probably because the cold climate makes life hazardous for the free-living larvae. Eskimo dogs are not known here to have ticks or fleas.

The locally common ground squirrel, *Citellus parryi barrowensis* (Merriam), carries fleas sparingly but identifications have not yet been reported for the few collected. A live *Citellus* at Anaktuvuk Pass, August 27, 1948, was carefully examined but no fleas were seen. On another at the same time, however, two fleas were seen of which one escaped. On captive *Citellus* at Pt. Barrow, September 1, 1948, which were taken some ninety miles south, several fleas were collected.

From a shrew (*Sorex o. obscurus* Merriam) which Dr. Robert Rausch took at Tolugak Lake, Anaktuvuk Pass, July 22, 1949, a single flea was taken (*Corrodopsylla curvata* (Rothschild)).

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EXPLANATION OF PLATES

PLATE IV

Finely broken-up drift wood material from the open beach of the northernmost tip of Alaska, the Point Barrow sandspit. Many Collembola, mites and dipterous larvae lived in this habitat, which was relatively stable because of feeble tidal change, constant humidity and relatively even, though low, temperatures. The occurrence of arthropods at this site demonstrates the ease with which they may be carried along Polar shores and become circumpolar in distribution.

PLATE V

Lemming runways at the northermost tip of Alaska, the Point Barrow sandspit. The grass grew luxuriantly in the vicinity of old Eskimo dugouts made with whalebones. Great numbers of yellowish Collembola, many *Spaniotoma* and other dipterous larvae and other arthropods were taken from the runways.

PLATE VI

Lemming winter nest exposed by the melting of the snow cover in June, although with a slight fall of new snow on the windward side; canvas work gloves indicating the size. From this damp nest material several thousand mites, Collembola and *Spaniotoma* larvae were taken and a few spiders and staphylinid beetles. Pt. Barrow.

PLATE VII

North front of the Endicott Mountains at Anaktuvuk Pass from an elevation somewhat above four thousand feet. Collembola and mites live in the lichen-moss growth on the rubble, swarms of mosquitoes and some other flies, stoneflies, beetles, moths and butterflies were also to be found at this elevation.

PLATE VIII

Arrow points to egg case of spider at 3500 feet in Anaktuvuk Pass. The spider (not shown) had spun a small web in a crevice between lichen-covered rocks on a talus slope.

PLATE IX

A female spider, *Aculepeira aculeata* Emerton, in her orb nest at 3500 feet in Anaktuvuk Pass. Fourteen mosquitoes and a moth were trapped in the webs.

PLATE X

Sandbar along the Anaktuvuk River on the north front of the Endicott Mountains at Anaktuvuk Pass. At this comparatively xerophilous site were such beetles as *Thanatophilus trituberculata* (Silphidae) and *Asaphidion, Cryobius, Bembidion* and *Elaphrus* (Carabidae). Many other species of insects occurred here in the thin growth of *Carex* near the water and among *Salix alexensis* to be seen at the left and farther back from the water. A number of spiders were carrying egg cases at this date (9 July).

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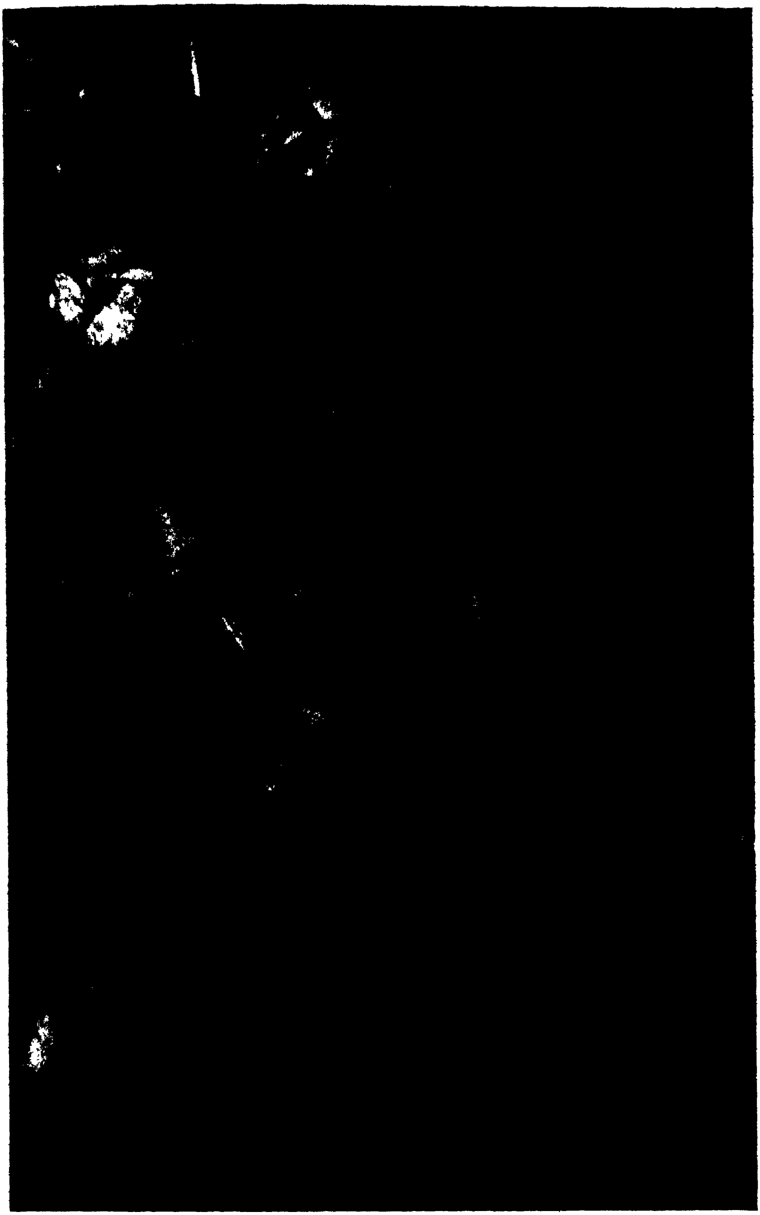

WEBER—ARCTIC ALASKAN INSECTS

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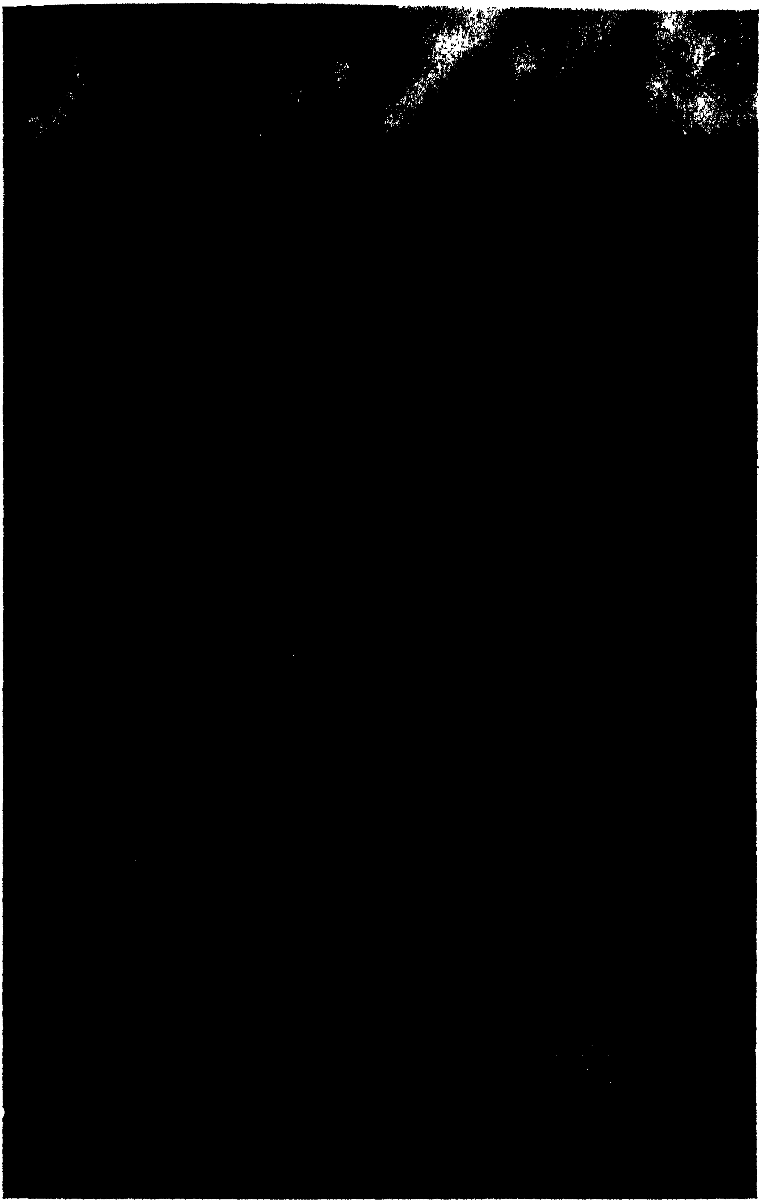

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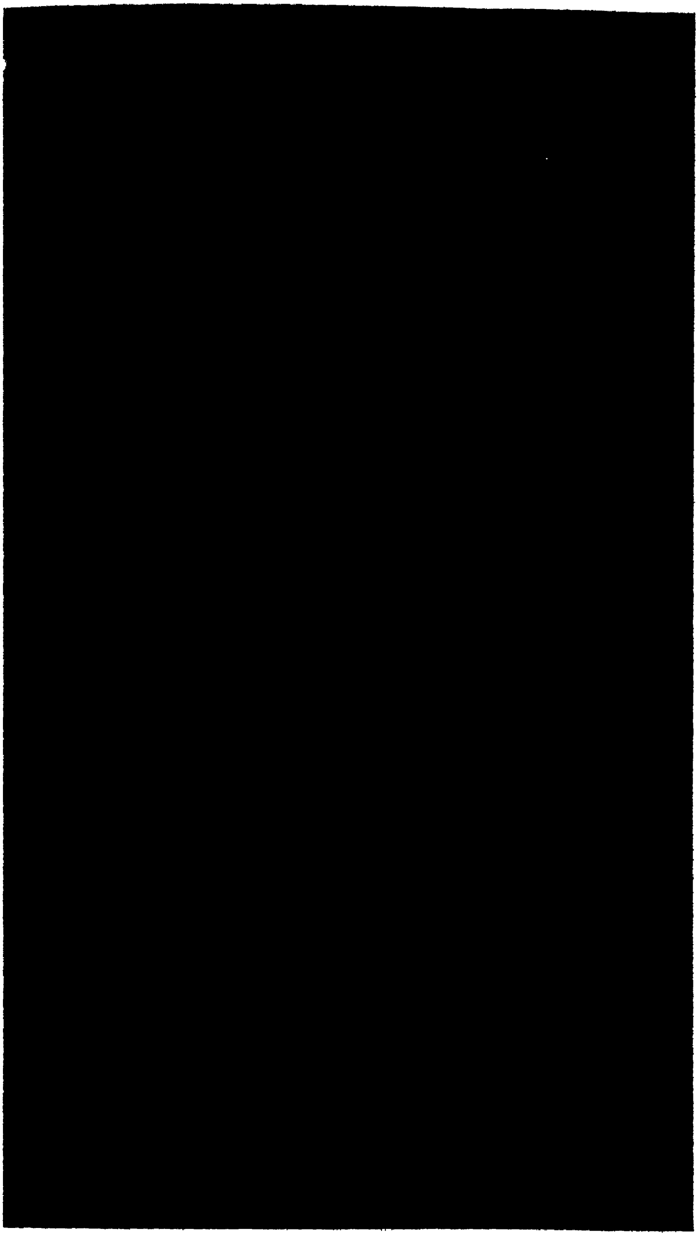

WEBER—ARCTIC ALASKAN INSECTS

A TAXONOMIC STUDY OF THE NEARCTIC SPIDER WASPS BELONGING TO THE TRIBE POMPILINI (HYMENOPTERA: POMPILIDAE). PART II: GENUS ANOPLIUS DUFOUR

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(Plates XI to XXII)

This is the second paper of a series of three, in which it is planned to review the systematics and bionomics of the Nearctic Pompilini. In the first part of this study,[1] the author presented certain introductory material, a key to the genera, and a systematic treatment of eight of the thirteen genera. Part III, yet to be published, will include four of the genera, as well as a check list of the Nearctic genera and species and an index to all three parts. To this part will also be appended such additions and corrections to the first two parts as seem necessary at that time.

The present part of this study includes the single genus *Anoplius*. This is the largest genus of the entire family in our fauna, including as it does some 43 species, some of them among our commonest Pompilidae. This genus has frequently gone by the name of *Psammochares,* a name now rejected by the International Commission of Zoological Nomenclature. The generic synonymy which follows is only a partial one, the reader being referred also to the synonymies given under the several subgenera.

IX. Genus **ANOPLIUS** Dufour

Psammochares Latreille, 1796, Précis des Caractères générique des Insectes, p. 115. [Type: *Sphex fusca* Linnaeus, 1761; designated by Latreille, 1803.]—Banks, 1912, Jour. N. Y. Ent. Soc., 19: 223. [*Et auct.*] [Suppressed by the Internat. Comm. Zool. Nomen. in Opinion 166, 1945.]

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[1] Evans, H. E., 1950, Trans. Amer. Ent. Soc., 75: 133-270.

Pompilus Fabricius, 1798, Suppl. Ent. Syst., pp. 212 and 246-252. [Type: *Pompilus viaticus* Fabricius (?=*Sphex viatica* Linnaeus, 1758[2];= *Sphex fusca* Linnaeus, 1761); designated by Latreille, 1810.]—Cresson, 1867, Trans. Amer. Ent. Soc., 1: 86. [In part.] [*Et auct.*] [*Nec Pompilus* in the sense of the Internat. Comm. Zool. Nomen., which in Opinion 166 designated *Pompilus pulcher* Fabricius as type.]

Anoplius Dufour, 1834, Ann. Soc. Ent. France, 2: 483. [Type: *Pompilus niger* Fabricius, 1775 (=*nigerrimus* Scopoli, 1763); designated by Fox, 1901.]—Sustera, 1913, Verh. zool.-bot. Ges. Wien, 62: 182, 206. [First used in approximately its present limits.]—Berland, 1925, Faune de France X, Hymen. vespiformes I, pp. 248-252.—Haupt, 1927, Deutsch. Ent. Zeitschr., Beiheft, pp. 159, 166, 230-247.—Wilcke, 1943, Overdruk uit Med. van.de Landbouwhoogeschool Wageningen, 47: 72-79.

The genus *Anoplius* is here used in the same sense as used by recent European authors, that is, to include those forms closely allied to *Pompilus* in which the apical tergite of the female is provided with numerous stout bristles and in which the claws of the male are bifid on all the tarsi. As thus defined it is a distinct and, I believe, natural genus. It is a very large genus in the New World, and there has been a strong temptation for American authors to split it into more convenient-sized genera. Some of these groups can be retained as subgenera, while others must be abandoned. It is possible that some of the subgenera here recognized will have to be discarded when the genus is more thoroughly studied in other parts of the world.

Generic characters.—Small to fairly large wasps, 3 to 30 mm. in length. American species all in large part black or blue-black, the abdomen in a number of species marked with rufous, the mandibles normally somewhat ferruginous apically. Pubescence and pilosity very variable, but the abdomen of the female always more or less setose ventrally beyond the basal sternite, and the apical tergite in this sex with at least a few stout bristles toward the posterior end which are directed caudad, often very densely bristly (Fig. 145).

Mandibles usually bidentate in the female, but in a few species unidentate, in the male usually unidentate, but in a few species bidentate. Labrum with the apical margin only slightly emarginate, protruding only slightly if at all from beneath the clypeus. Clypeus from 2 to 3 times as broad as high, its apical margin truncate, concave, or emarginate. Malar space very short. Antennae elongate, segment 3 in the female at least 3 times as long as its

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[2] The identity of *Sphex viatica* Linnaeus has been much disputed. *Cf.* Pate, 1946, Trans. Amer. Ent. Soc., 72: 126, and Verhoeff, 1947, Tijdschr. voor Ent., 88: 334-336.

greatest diameter, segment 3 in the male at least twice as long as its greatest diameter.

Pronotum short, usually considerably shorter than the mesonotum, the anterior slope rather even. Postnotum a transverse band of variable width, never longer than the metanotum and usually considerably shorter, its margins nearly parallel. Propodeum with the contours even, or occasionally somewhat protuberant postero-laterally, sometimes with a steeply declivous area posteriorly. Front tarsus of the female with or without a comb. Apical tarsal segments spined beneath in the female, often so in the male. Claws of the female dentate, except in one species where they are unusually long, unsymmetrical, and bifid. All the claws of the male bifid, the inner claws of the front tarsus always strongly curved and deeply cleft, the apical segment of the front tarsus in this sex either modified or not. Pulvillar comb well developed, in the female of from 12 to 24 strong, subparallel setulae, in the male of from 8 to 24 setulae.

Hind wing with the anal lobe small, at most half the length of the submedian cell. Cubitus arising at, beyond, or slightly before the tip of the submedian cell. Fore wing with the marginal cell never removed by more than twice its own length from the wing-tip; third discoidal cell not more than 1½ times its own length from the wing margin. Second and third submarginal cells commonly somewhat narrowed above by the arcuation of the first and third transverse cubital veins, the third submarginal sometimes triangular or petiolate.

Abdomen of the female stout, subfusiform, the pygidium bristly as described above. Abdomen of the male more slender and elongate, the apical segments never strongly telescoped, though often slightly so. Venter of male either smooth, slightly setose, or with dense tufts of hair on some of the sternites. Subgenital plate variously developed, the basal sclerite simple, more or less V-shaped. Genitalia variously developed, showing excellent specific characters throughout the genus; aedoeagus never with spines or setae on the shaft; parapenials simple and slender; basal hooklets usually strong, single, but in two subgenera wanting or reduced to small flaps.

Biology.—The species of this genus occupy a variety of habitats, some being rather restricted ecologically, and others very wide-ranging. The prey consists of spiders of a wide variety, but perhaps most commonly Lycosidae. Some species are rather specific in their prey-preferences, while the majority apparently are rather unselective. The nest is a simple gallery in the earth or a ready-made niche. Further generalizations can hardly be made; the biology is discussed under the various subgenera and species where it is known.

Distribution.—This genus occurs throughout the world except that, so far as I know, there are no endemic species in the Australian region. There are numerous species in the Palaearctic, Oriental, and Ethiopian regions, but the genus is nowhere so well represented as in the Nearctic and Neotropical regions. The 43 Nearctic species can be placed in 6 subgenera, which seem to represent natural groups; the lines between them, however, are not always clear-cut.

Key to Subgenera

Females

1. Front tarsus without a comb, the second segment with only 1 to 3 very small spines on the outer side, much shorter than that at the apex of the segment; transverse median vein of fore wing usually meeting the media beyond the origin of the basal vein ....F. **Anoplius** Dufour

   Front tarsus with a true comb, that is, there is a single spine on the outer side near the middle of the second segment which is as long as that at the apex of the segment 2

2. Anterior margin of clypeus with a distinct median emargination; posterior margin of pronotum arcuate; head, thorax, and propodeum with abundant erect hairs ....A. **Lophopompilus** Radoszkowski

   Anterior margin of clypeus with a distinct emargination only in a few species, and in these either the pronotum is angulate behind or the propodeum is without erect hairs or practically so 3

3. Transverse median vein of fore wing meeting the media beyond the origin of the basal (Fig. 153); third submarginal cell usually petiolate; spines of the tarsal comb from one to two times as long as the thickness of the tarsus; wings never wholly deep fuliginous
E. **Pompilinus** Ashmead

   Transverse median vein of fore wing meeting the media at or slightly before the origin of the basal (Fig. 152) (rarely slightly beyond, but in this case either the spines of the tarsal comb are more than twice as long as the thickness of the tarsus, or the wings are wholly deep fuliginous) 4

4. Marginal cell very long, removed from the wing-tip by not more than its own length, the radial vein nearly evenly arched; third submarginal cell large, wider on the radius than the second submarginal; front narrow; spines of the tarsal comb very short ....C. **Anopliodes** Banks

   Marginal cell of variable length, the radial vein always somewhat angled at the third transverse cubital vein; third submarginal cell much narrowed above, shorter on the radius than the second, occasionally triangular or petiolate 5

5. Apical margin of clypeus with a median emargination; front narrow, the middle interocular distance not over .56 times the transfacial distance
B. **Notiochares** Banks

Apical margin of clypeus truncate or slightly concave, except in one species in which the front is very broad, the middle interocular distance varying from .57 to .60 times the transfacial
D. **Arachnophroctonus** Howard

Males

1. Subgenital plate with a large plumose process at its base which projects from the emargination of the preceding sternite (Fig. 116); head, thorax, and propodeum with abundant erect hairs
A. **Lophopompilus** Radoszkowski

Subgenital plate without a basal plumose process 2

2. Sternite 4 of the abdomen with a semicircular area of dense, felt-like pubescence along its posterior margin; subgenital plate with a sharp, V-shaped incision apically, internally with lateral expansions which terminate in a group of stout setulae (Fig. 118)
B. **Notiochares** Banks

Sternite 4 without such a patch of felt-like pubescence; subgenital plate without an apical V-shaped incision or basal lateral expansions 3

3. Last segment of front tarsus unmodified, the sides nearly parallel, not at all produced; wings subhyaline basally, darker apically; marginal cell long, the third submarginal wide above; basal hooklets of genitalia wanting ....C. **Anopliodes** Banks

Last segment of front tarsus with the inner margin slightly to strongly produced, the segment thus asymmetrical (barely so in one species having wholly deep fuliginous wings); basal hooklets well developed 4

4. Transverse median vein of fore wing meeting the media at or slightly before the origin of the basal (Fig. 152) 5

Transverse median vein of fore wing meeting the media beyond the origin of the basal vein (Figs. 153 and 154) 6

5. Either (a) the wings rather heavily infuscated, usually wholly and uniformly so; or (b) the propodeum without more than some very short, inconspicuous erect hairs; propodeum with the slope very slight in front, steepened behind ....D. **Arachnophroctonus** Howard

Wings hyaline or subhyaline, with a darker marginal band; propodeum with noticeable dark hairs; slope of propodeum low and nearly even from front to rear ....F. **Anoplius** Dufour

6. Propodeum, in profile, with the slope very slight in front, steepened behind (Fig. 151); third submarginal cell nearly always petiolate; parameres of genitalia long, usually broadened apically
E. **Pompilinus** Ashmead

Propodeum with the slope low and nearly even from front to rear (as in Fig. 147); third submarginal cell only occasionally petiolate; parameres slender or broad, but not broader apically than near the base, often rather short .... F. **Anoplius** Dufour

A. Subgenus LOPHOPOMPILUS Radoszkowski

Lophopompilus Radoszkowski, 1887, Hor. Soc. Ent. Ross., 21: 42. [Type: *Pompilus grandis* Eversmann, 1849 (=*samariensis* Pallas, 1771); desig. by Ashmead, 1902.]—Ashmead, 1902, Canad. Ent., 34: 81.—Banks, 1912, Jour. N. Y. Ent. Soc., 19: 224. [Subgenus of *Psammochares*.]—Banks, 1919, Bull. Mus. Comp. Zool., 63: 231. [Genus.]—Regan, 1923, Ann. Ent. Soc. Amer., 16: 177-194. [Genus; revision of Nearctic species.]—Dreisbach, 1949, Ent. Amer., (n. s.) 29: 7, 9, 34, pl. I, fig. 2. [Genus.]

Pompilogaster Howard, 1901, The Insect Book, pl. V, fig. 19. [Type: *Pompilus aethiops* Cresson, 1865; monobasic.]

Pompilogastra Ashmead, 1902, Canad. Ent., 34: 81. [Type: *Pompilus aethiops* Cresson, 1865; monobasic.]

The mostly rather large wasps of this subgenus are among the best known and most often collected of American spider wasps. The plumose process at the base of the subgenital plate of the male (Figs. 116 & 117) is unique in the family. The emargination of the clypeus of the female is a less distinctive character, as several other species of *Anoplius* belonging to other subgenera share it; two other characters, the completely arcuate posterior pronotal margin, and the very hairy pronotum and propodeum, combined with it will, however, separate the females from these species.

Subgeneric characters.—Medium-sized to large wasps (8-25 mm.); color black, the second abdominal tergite sometimes marked with orange. Body with conspicuous black erect hair on the following parts: scape (usually), front, vertex, temples, propleura, pronotum, coxae, femora (sometimes), mesopleura, scutellum, metanotum, propodeum, first abdominal tergite, and to some extent the sternites and the apical tergites; pygidium of female densely bristly. Mandibles with a single strong tooth on the inner margin, the females sometimes with a weak second tooth basad of this. Clypeus large, slightly elevated, the apical margin in the male truncate or very slightly concave, in the female with a well-defined median emargination beneath which the truncate, bristly apical margin of the labrum may be seen. Front broad; eyes somewhat convergent above the middle. Antennae long and slender, segment three considerably longer than four in the female, usually slightly so in the male.

Posterior margin of pronotum evenly arcuate, in some males with a faint suggestion of a median angulation. Slope of propodeum rather even, or slightly steeper behind. Front tarsus of female with a well-developed comb, the basitarsus with from 3 to 5 comb-spines, and 3 or 4 additional, shorter spines below these. Apical tarsal segments with a median row of from 3 to 6 spines beneath in the female, weakly or not at all spined beneath in the male. Last segment of front tarsus of male not modified, more or less parallel-sided, the inner claw of this tarsus strongly curved, deeply cleft. Pulvillar comb strong, of about 24 setulae in the female, about 14 in the male. Hind wing with the cubitus arising at or a little before the tip of the submedian cell. Fore wing with the basal vein arising at or a little before the juncture of the transverse median. Marginal cell about or a little less than its own length from the wing-tip; third submarginal cell much narrowed above, occasionally triangular; third discoidal cell long, less than its own length from the wing margin.

Penultimate sternite of male with a deep emargination, from which protrudes a compressed, finger-like lamella, clothed densely with hairs, which has its origin at the base of the subgenital plate, apparently as a posterior prolongation of the basal sclerite; subgenital plate broad, nearly flat, the apex rounded or subtruncate (Figs. 116 & 117). Genitalia with the aedoeagus simple and slender, feebly bilobed apically; parapenials slender and elongate, closely embracing the aedoeagus. Basal hooklets strong, single; digitus slender, spindle-shaped, provided with numerous setae which are directed laterad. Parameres slender, with a distinct sub-basal squama, more or less setose.

Biology.—The species of *Lophopompilus* are wide-ranging, strong-flying forms; several are most often found in open fields or meadows, one (*cleora* Banks) in sand dunes, and one (*carolinus* Banks) in woodlands. Both sexes visit flowers of many kinds; there are several records of females having been taken at light at night. Despite the relative abundance of members of this group, little is known of their nesting habits, except that they prey on large spiders, chiefly Lycosidae, and nest in the ground. A patient observer in almost any part of the country could make a valuable contribution by studying the biology of *A.* (*L.*) *aethiops* Cresson, one of our commonest Pompilidae.

Distribution.—Holarctic Region; represented by the genotype and several other species in the Palaearctic fauna, and by five species in North America.

Key to Species

Females

1. Color black, the pubescence more or less evidently reflecting deep bluish or purplish; length 13-23 mm.; third antennal segment subequal to or a little shorter than the upper interocular distance 2

   Color black, the second abdominal tergite marked with orange; pubescence obscurely reflecting deep blue-green; third antennal segment slightly to considerably greater than upper interocular distance, or the size under 13 mm. 3

2. Front basitarsus with 3 rather short comb-spines, rarely with a small fourth; emargination of clypeus rather broad; eyes converging but slightly above, upper interocular distance from .82 to .88 times the lower interocular; post-ocellar line less than the ocello-ocular
   1. **aethiops** (Cresson)

   Front basitarsus with 4 longer comb-spines, rarely with a short fifth; emargination of clypeus more narrow and sharply-defined; eyes converging more above, upper interocular distance from .72 to .8 times the lower interocular; post-ocellar line subequal to or slightly less than the ocello-ocular ....2. **cleora** (Banks)

3. Size 9 to 13 mm.; wings rather lightly infuscated; third antennal segment equal to from .83 to .93 times the upper interocular distance; upper interocular distance from .78 to .88 times the lower interocular
   3. **carolinus** (Banks)

   Size 15 to 26 mm.; wings fuliginous, violaceous; third antennal segment at least as great as the upper interocular distance; eyes more strongly convergent above 4

4. Front basitarsus usually with 3 comb-spines; upper interocular distance about .75 times the lower interocular; third antennal segment from 1.0 to 1.2 times the upper interocular distance; emargination of clypeus more narrow and sharply defined ....4. **atrox** (Dahlbom)

   Front basitarsus usually with 4 comb-spines; upper interocular distance about .65 times the lower interocular; third antennal segment from 1.2 to 1.4 times the upper interocular distance; emargination of clypeus rather broad and shallow ....5. **bengtssoni** (Regan)

Males

1. Wings hyaline, the outer margins with a fuscous band; pubescence of head and thorax in large part silvery; parameres of genitalia straight, rather sparsely hairy along the outer margin and the apical fourth of the ventral surface ....3. **carolinus** (Banks)

   Wings wholly fuliginous, more or less violaceous; pubescence wholly dark; parameres sinuate or, if straight, rather bushy-haired on the outer margin and apical third of the ventral surface 2

2. Color black, the pubescence more or less strongly reflecting deep bluish or purplish; plumose process of subgenital plate extending less than half the distance from the basal sclerite to the apex of the plate (Fig. 116) 3

Color black, the second abdominal tergite marked with orange, the pubescence obscurely reflecting deep blue-green; plumose process longer, generally extending more than half way from the basal sclerite to the apex of the subgenital plate (Fig. 117) 4

3. Post-ocellar line distinctly less than ocello-ocular; eyes converging less above, upper interocular distance about .95 times the lower interocular; front convex, rather full between the eyes; parameres with a distinct subapical curvature (Fig. 72) ....1. **aethiops** (Cresson)

Post-ocellar line subequal to ocello-ocular; eyes converging somewhat more above, the upper interocular distance about .9 times the lower interocular; front less convex, rather flat between the eyes; parameres straight (Fig. 73) ....2. **cleora** (Banks)

4. Eyes converging slightly above, upper interocular distance from .88 to .95 times lower interocular; post-ocellar line usually a little less than the ocello-ocular, the ocelli of average size; parameres linear (Fig. 76) 4. **atrox** (Dahlbom)

Eyes more strongly convergent at the top, the upper interocular distance from .80 to .88 times the lower interocular; ocelli rather large, the post-ocellar line usually slightly greater than the ocello-ocular; parameres somewhat broadened apically (Fig. 75) 5. **bengtssoni** (Regan)

1. Anoplius (Lophopompilus) aethiops (Cresson)

(Pl. XI, fig. 72; pl. XVIII, fig. 116.)

Pompilus aethiops Cresson, 1865, Proc. Ent. Soc. Phila., 4: 451. [Lectotype: ♀; Colorado (no further data); A.N.S.P. no. 413.]—Cresson, 1867, Trans. Amer. Ent. Soc., 1: 87.—Provancher, 1882, Nat. Canad., 13: 35. [Quebec.]—Fox, 1894, Proc. Calif. Acad. Sci., (2)4: 98. [Lower Calif.] —Dalla Torre, 1897, Cat. Hymen., VIII, p. 270.

Pompilogaster aethiops Howard, 1901, The Insect Book, pl. V, fig. 19.

Pompilogastra aethiops Ashmead, 1902, Canad. Ent., 34: 81.

Anoplius (Sophropompilus?) aethiops Viereck, 1906, Trans. Amer. Ent. Soc., 32: 223. [Galveston, Texas.]

Anoplius aethiops Smith, 1910, Ann. Rpt. N. J. State Mus. 1909, p. 673.

Psammochares ilione Banks, 1910, Psyche, 17: 249. [Type: ♀; Falls Church, Va., 12 Sept. (N. Banks); M.C.Z. no. 13,667.]—Regan, 1923, Ann. Ent. Soc. Amer., 16: 179. [Placed in synonymy with *aethiops*.]

Psammochares (Lophopompilus) aethiops Banks, 1912, Jour. N. Y. Ent. Soc., 19: 224.—Rohwer, 1916, Conn. Geol. Nat. Hist. Survey Bull. 22, pp.

633, 634.—Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 986. [N. Y.]—Johnson, 1930, List Insect Fauna Nantucket, p. 111.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 123. [N. C.]

Psammochares (*Lophopompilus*) *ilione* Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Johnson, 1930, List Insect Fauna Nantucket, p. 110.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 123.

Lophopompilus aethiops Banks, 1919, Bull. Mus. Comp. Zool., 63: 231.—Regan, 1923, Ann. Ent. Soc. Amer., 16: 178-191, pl. XI, fig. 3.—Dreisbach, 1949, Ent. Amer., (n. s.) 29: 34, pl. I, fig. 2.

Lophopompilus azotus Banks, 1929, Psyche, 36: 326. [Type: ♀; Springfield, S. D., 14 Sept. 1925 (H. C. Severin); M.C.Z. no. 16,232.] New synonymy.

This widely distributed species is easily confused only with *cleora,* but a number of characters, as indicated in the keys, serve to separate these species. In determining a mixed series of males, I have found it convenient to relax the specimens and draw out the genitalia to the extent where the parameres can be seen, rather than attempt to interpret the more subtle external characters. The parameres of *aethiops* have a distinct preapical curvature, whereas in *cleora* they are straight.

FEMALE.—Length 18 (13-23) mm. Color black; wings fuliginous, violaceous. Body clothed with a fine dark pubescence which reflects deep metallic colors, chiefly bluish. Clypeus about 2.7 times as broad as high, its apical margin with a slightly raised rim, medially with a broad, moderately deep, arcuate emargination. Front broad, the middle interocular distance from .6 to .63 times the transfacial distance. Inner orbits subparallel below, converging slightly above, the upper interocular distance equal to from .82 to .88 times the lower interocular. Ocelli in a rather close triangle on the vertex, the front angle usually a little greater than a right angle; ocello-ocular line always distinctly greater than the post-ocellar. First four antennal segments in a ratio of about 4:1:7:5, segment 3 slightly shorter than the upper interocular distance.

Propodeum strongly convex, the median line impressed on the anterior half, and with a rather flat semicircular declivity behind. Front basitarsus with three comb-spines (rarely a small fourth, basal one), the apical one about half the length of the second tarsal segment. Fore wing with the second and third submarginal cells both four-sided, the second narrowed by from .1 to .4 above, the third narrowed by from .7 to .8 above.

MALE.—Length 13.5 (9-18) mm. Color black, clothed with a dark pubescence which in proper light rather strongly reflects deep bluish, as in the female. Scape hairy above and below; head and thorax with abundant erect hairs; abdominal sternites and basal and apical tergites all slightly hairy. Wings in color and venation as in the female.

Clypeus about 2.2 times as broad as high, its apical margin slightly arcuately concave. Front broad, middle interocular distance from .63 to .66 times the transfacial distance. Inner orbits diverging slightly to the middle, converging somewhat above, upper interocular distance about .95 times the lower interocular. Post-ocellar line usually slightly less than the ocello-ocular. First four antennal segments in a ratio of about 3:1:3.2:3, segment 3 more than 3 times as long as thick. Pronotum arcuate behind; propodeum weakly impressed medially. Longer spur of hind tibia about .6 the basitarsus.

Emargination of sternite 6 large, V-shaped. Subgenital plate (Fig. 116) with the basal process relatively short, the hairs on it very long. Genitalia (Fig. 72) with the parameres slender, slightly arched, with a distinct preapical curvature; squama, outer margin, and apex of parameres setose, the ventral surface with only a few setae apically. Volsellae with several long hairs at the base, the digitus clothed with numerous rather long setae. Aedoeagus simple, slightly exceeding the parapenials, both of these somewhat shorter than the parameres.

Biology.—This species is an inhabitant of open areas, fields, meadows, and prairies. I have sometimes taken it in gravel pits, but never in open sand. Despite its relative abundance, nothing is known of its nesting habits; it is possible that it nests among tall grass, where it escapes notice. The only record of its prey is a female from Amherst, Mass. [Mass.] pinned with the spider *Lycosa frondicola* Emerton, ♂ [det. B. J. Kaston].

Anoplius aethiops is principally a late summer species in the northern part of the United States and in southern Canada, where there is a single generation a year; in the South there are at least two generations a year. The species is commonly taken on flowers, and is known to visit the following: *Daucus carota, Pastinaca sativa, Conium maculatum, Tecoma radicans, Solidago* spp., *Eupatorium perfoliatum, Asclepias* spp., *Sphaeralcea angustifolia, Tamarix gallica, Cleome* spp., *Melilotus* sp., and *Eriogonum* sp.

Distribution.—This species occurs transcontinentally from the Lower Austral to the Transition Zones. It is a rather common wasp over much of its range, but apparently much less common in the southeastern United States, perhaps through competition with a very common wasp of similar habits, *A.* (*Notiochares*) *amethystinus atramentarius* (Dahlbom).

Specimens seen: 630 (311 ♀♀, 319 ♂♂). The following records appear to define the periphery of its range: NOVA SCOTIA: 1 ♂, Kentville, Aug. [CNC]; QUEBEC: 1 ♀, Hemmingford, Aug. [CNC]; ONTARIO: 1 ♀, 4 ♂♂, Ottawa, Aug.-Sept. [CNC]; MICHIGAN: Ingham Co., 1 ♂, 11 Aug. [Coll. R. L. Fischer]; WISCONSIN: Wood Co., 1 ♀, Cranmoor, Aug. [USNM]; MINNESOTA: Ramsey Co., 1 ♀, 25 Aug. [Minn.]; SOUTH DAKOTA: Butte Co., 1 ♂, Newell, Aug. [SDS]; MONTANA: 1 ♀, 1 ♂ (no further data) [ANSP]; BRITISH COLUMBIA: 1 ♀, Vernon, 5 Aug. [CNC]; CALIFORNIA: Riverside Co., 1 ♀, Palm Springs, 6 July [CIS]; MEXICO: Durango, 1 ♀, 1 ♂, Coyotes, 8300 feet, 8 Aug. [AMNH]; Dist. Federal, 1 ♂, July-Aug. [USNM]; TEXAS: Dimmit Co., 2 ♀♀, Carrizo Springs, Oct.-Nov. [RWS]; ALABAMA: Mobile Co., 1 ♀, 26 Nov. [CAS]; GEORGIA: 2 ♀♀ (no further data) [ANSP]; NORTH CAROLINA: Carteret Co., 1 ♀, Cherry Point [CIS].

2. **Anoplius (Lophopompilus) cleora** (Banks) (Pl. XI, fig. 73.)

Psammochares cleora Banks, 1917, Bull. Mus. Comp. Zool., 61: 105. [Type: ♀; Los Angeles, Calif., 3 May 1915 (M. C. VanDuzee); M.C.Z. no. 10,020.]

Psammochares (*Lophopompilus*) *cleora* Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 987. [Ithaca and L. I., N. Y.]—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 123. [N. C.]

Lophopompilus cleora Banks, 1919, Bull. Mus. Comp. Zool., 63: 231.—Regan, 1923, Ann. Ent. Soc. Amer., 16: 178-191, pl. XI, fig. 4, & pl. XII, figs. 3, 7.

Anoplius (*Lophopompilus*) *cleora* Krombein, 1950, Jour. Elisha Mitchell Sci. Soc., 65: 264.

This species is distinguishable from the very similar *aethiops* by the characters mentioned in the key and under that species; it occupies quite a different ecological niche than that species, being very partial to sandy places.

FEMALE.—Length 15 (13-19) mm. Color black; pubescence very dark, in proper light reflecting deep bluish or purplish. Wings wholly fuliginous, violaceous. Body extensively hairy, including the scape, the coxae, and often the femora to some extent. Clypeus slightly shorter than in *aethiops*, about 3 times as broad as high; apical margin with a more narrow and sharply defined emargination. Front broad, the middle interocular distance about .6 to .63 times the transfacial distance. Inner orbits subparallel below, or very slightly converging to the middle; orbits distinctly converging above, the upper interocular distance from .72 to .8 times the lower interocular. Ocelli in a compact triangle, forming a right angle or a little more or less in front; post-ocellar line subequal to or a little less than the ocello-ocular.

First four antennal segments in a ratio of about 4:1:7:5, the third segment equal to or slightly shorter than the upper interocular distance, varying from .87 to 1.0 times the upper interocular.

Pronotum arcuate behind, sometimes with a faint suggestion of a median angulation. Propodeum convex, posteriorly with a rather flat declivity. Front basitarsus with four comb-spines (rarely with a small fifth, basal one); the spines are longer than in *aethiops* and, unless worn, the apical spine on the basitarsus is over half the length of the second tarsal segment, often nearly equal to it. Venation as usual in the subgenus; marginal cell usually slightly less than its own length from the wing-tip; third submarginal cell narrowed by .6 to .8 above.

MALE.—Length 13 (9.5-15) mm. Color of body, wings, and pubescence as in female. Clypeus convex, about 2.2 times as broad as high, its apical margin slightly concave. Middle interocular distance usually about .62 times the transfacial distance. Inner orbits distinctly convergent above, the upper interocular distance from .85 to .95 times the lower interocular. Front rather flat, less full between the eyes than in *aethiops*. Ocelli moderately large, in a compact triangle the front angle of which is about a right angle; post-ocellar line subequal to or very slightly greater or less than the ocello-ocular. First four antennal segments in a ratio of about 3:1:3.2:3, the third segment more than three times as long as thick.

Posterior pronotal margin arcuate, often with a vague suggestion of a median angulation. Slope of propodeum low and even, a little steeper behind; median line weakly if at all impressed. Abdomen with the emargination of the sixth sternite broadly V-shaped, at the base with a narrowly V-shaped extension. Subgenital plate much like that of *aethiops*, but the basal process slightly longer and the hairs on it usually slightly shorter. Genitalia (Fig. 73) with the parameres rather stout, straight, only slightly exceeding the parapenials; squama, outer margin, apex, and outer portion of ventral surface of parameres strongly setose; other genitalic structures much as in *aethiops*.

Biology.—This species is a rather strict psammophile, being partial to open sandy areas, especially along watercourses. Although local in its distribution, it is often common in its habitat. Dates of collection vary widely, and indicate two or more generations a year throughout its range. In Manhattan, Kansas, it is a common species along riverbanks in the autumn, and I have taken it as late as the 19th of November. This species only rarely visits flowers, but I have taken a few specimens on *Solidago* and on *Baccharis* (Compositae).

This insect nests in short tunnels in the sand which it provisions with Lycosid spiders. I have not observed the full nesting process, but have found it in the evening constructing its burrows, presumably in which to spend the night. I have also taken a single female with the spider *Arctosa littoralis* (Hentz) ♂ [det. B. J. Kaston]. The wasp was walking backward over the sand dragging the spider by one of its legs. This individual was approached by several males and eventually left its spider briefly to mate, and was captured *in copula.*

Distribution.—This form occurs transcontinentally in the Lower and Upper Austral Zones, but, like the preceding species, is rare or absent in the Southeast. It enters the lower fringes of the Transition Zone in the East; the record from Ithaca, N. Y., given by Leonard (1926) is, however, based on a misdetermined *aethiops.*

Specimens seen: 200 (127 ♀♀, 73 ♂♂). Marginal records are as follows: PRINCE EDWARD ISLAND: 2 ♀♀, 2♂♂, Canad. Nat. Park, July [CNC]; NEW BRUNSWICK: 1 ♀, Chatham, Aug. [CNC]; VERMONT: 1 ♀, Burlington, 1 Sept. [MCZ]; NEW YORK: Nassau Co., 1 ♀, Sea Cliff [CU]; NEW JERSEY: Gloucester Co., 1 ♂, Westville, July [CU]; WEST VIRGINIA: Randolph Co., 1 ♀, Cheat Mt., 2000 feet, Aug. [CM]; NEW YORK: Wayne Co., 1 ♀, 4 Aug. [HEE]; ONTARIO: 1 ♀, Ottawa, Aug. [CNC]; MICHIGAN: Cheboygan Co., 1 ♀, Douglas Lake, 23 Aug. [Minn.]; MINNESOTA: Ramsey Co., 1 ♀, St. Anthony Park [Minn.]; NORTH DAKOTA: Ramsey Co., 1 ♀, Devil's Lake, 29 June [CU]; COLORADO: Mesa Co., 1 ♂, Grand Junction, 12 June [CAS]; BRITISH COLUMBIA: 1 ♂, Vernon, 25 Aug. [CNC]; OREGON: Josephine Co., 1 ♂, Grant's Pass, 6 July [OSC]; CALIFORNIA: Humboldt Co., 1 ♀; Fort Seward, May [CIS]; BAJA CALIFORNIA: 2 ♂♂, La Paz, June [CAS]; ARIZONA: Cochise Co., 1 ♀, Huachuca Mts., June [CAS]; TEXAS: Jeff Davis Co., 9 ♀♀, 5 ♂♂, Limpia Canyon, Davis Mts., July [HEE, ANSP]; KANSAS: Reno Co., 4 ♀♀, 7 ♂♂, 18 June [HEE, KSC]; Riley Co., 22 ♀♀, 10 ♂♂, Manhattan, 18 Sept.-19 Nov. [KSC, HEE, Coll. R. L. Fischer]; INDIANA: 1 ♀ (no further data) [USNM]; NORTH CAROLINA: Dare Co., 1 ♀, Kill Devil Hills, 4 June [KVK].

3. **Anoplius (Lophopompilus) carolinus** (Banks) new combination (Pl. XI, fig. 74.)

Lophopompilus carolina Banks, 1921, Ann. Ent. Soc. Amer., 14: 20. [Type: ♀; Blowing Rock, N. C., Sept. 1915; M.C.Z. no. 13,668.]—Regan, 1923, Ann. Ent. Soc. Amer., 16: 179.

Psammochares (*Lophopompilus*) *carolina* Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 123. [N. C., several localities.]—Brimley, 1938, Insects No. Carolina, p. 433.

This is a considerably smaller *Lophopompilus* than our other native species, and unlike any of these is rather strictly a woodland species. The male has not previously been recognized; it is without the orange markings of the female, but is easily told by the mostly hyaline wings.

FEMALE.—Length 10.5 (9-13) mm. Color black, the second abdominal tergite with a pair of orange spots, sometimes confluent on the median line. Wings lightly infuscated, darker along the outer margins, non-violaceous. Pubescence brownish-fuscous, scarcely reflecting metallic colors. Scape slightly hairy; body in general slightly less strongly hairy than in the other species of the subgenus.

Clypeus short, transverse, about 3.2 times as broad as high; anterior margin with a broad, rather deep arcuate emargination. Front broad, middle interocular distance from .58 to .61 times the transfacial; eyes converging somewhat above, upper interocular distance from .78 to .88 times the lower interocular. Ocelli in a compact triangle, the front angle a right angle or slightly less; postocellar line less than ocello-ocular about as 4:5. First four antennal segments in a ratio of about 3.5:1:5:4, segment 3 equal to from .83 to .93 times the upper interocular distance.

Pronotum arcuate behind, often with a weak median angulation. Slope of propodeum low and rather even, the median line lightly impressed anteriorly. Tarsal comb consisting of spines scarcely longer than the width of the tarsus; basitarsus with 3 comb-spines, the apical one about a third the length of the second tarsal segment. Marginal cell of fore wing about its own length from the wing-tip, the radial vein nearly evenly arched. Third submarginal cell narrowed by at least half above, usually nearly or quite triangular, occasionally petiolate.

MALE.—Length 9 (8-10) mm. Color black; wings hyaline or subhyaline, the outer margins and upper half of the marginal cell with a distinct fuscous band. Posterior pronotal margin sometimes with a faint pale stripe. Pubescence over the greater part of the head and thorax silvery, that of the abdomen sometimes in part silvery. Clypeus about 2.4 times as broad as high, its apical margin slightly concave. Middle interocular distance from .62 to .66 times the transfacial. Inner orbits nearly parallel, the upper and lower interocular distances nearly equal, the orbits slightly emarginate at the middle. Ocelli about as in the female. First four antennal segments in a ratio of about 3:1:3:3, the third segment about 2.5 times as long as thick.

Posterior pronotal margin arcuate or vaguely angulate; slope of propodeum low and even, the median line weakly impressed. Longer spur of hind tibia about three-fourths the length of the basitarsus. Wing venation as in the female. Abdomen with sternite 6 broadly emarginate behind, with a narrow slit medially. Subgenital plate of the usual type in the subgenus, the basal process rather long, extending more than half way from the basal sclerite to the apex of the plate. Genitalia (Fig. 74) with the parameres slender, straight, setose on the squama, outer margin, and apex, with a few setae on the ventral surface near the apex. Genitalia otherwise very similar to those of *cleora.*

Biology.—This species occurs from late June to late August in open woodlands, where it may usually be found in sunny spots, running or flying over the low foliage and debris. Its common associates are *Anoplius* (*Anoplius*) *virginiensis* (Cresson) and *Priocnemis germana* (Cresson). Both sexes occasionally visit the flowers of wild carrot along the borders of woods. There is undoubtedly but one generation a year.

The only record of the prey of this species is that of a female taken by the author at Ithaca, N. Y., with the spider *Wadotes* sp., young ♀ (Agelenidae) [det. B. J. Kaston]. The wasp was dragging the spider over the forest floor, leaving it on the ground at frequent intervals while it explored crevices under sticks and leaves, presumably for a suitable nesting site.

Distribution.—This form appears to be restricted to the Appalachian region of the eastern United States, ranging from southern Quebec to northern Georgia.

Specimens seen: 95 (60 ♀♀, 35 ♂♂). QUEBEC: 2 ♀♀, Hull, Aug. [CNC]; MASSACHUSETTS: Hampshire Co., 1 ♀, Aug. [Mass.]; CONNECTICUT: Litchfield Co., 2 ♀♀, Aug. [MCZ]; Tolland Co., 5 ♀♀, Aug. [HEE]; NEW YORK: Essex, Jefferson, Orange, and Tompkins Cos., 27 June-18 Aug. [CU, AMNH, CM, HEE]; NEW JERSEY: Bergen Co., 2 ♀♀, Aug. [MCZ]; PENNSYLVANIA: Centre, Dauphin, Lancaster, Fayette, York, and Westmoreland Cos., 20 June-22 July [PSC, CM, USNM]; MARYLAND: Cecil and Montgomery Cos., June-Aug. [USNM, MCZ, MSV]; VIRGINIA: Augusta Co., 1 ♀, 31 Aug. [USNM]; WEST VIRGINIA: Randolph Co., 5 ♀♀, June-Aug. [CM]; NORTH CAROLINA: Buncombe and Watauga Cos., Aug.-Sept. [MCZ, HEE]; GEORGIA: Fulton, Lumpkin, Rabun, and Union Cos., 27 June-31 Aug. [EU, USNM].

4. **Anoplius (Lophopompilus) atrox** (Dahlbom)

(Pl. XI, fig. 76; pl. XVIII, fig. 117.)

Pompilus atrox Dahlbom, 1844, Hymen. Europ., I, p. 63. [Type: ♀; So. Carolina (no further data); Univ. of Lund, Sweden (not seen by present author).]—F. Smith, 1855, Cat. Hymen. Brit. Mus., III, p. 157.—Cresson, 1867, Trans. Amer. Ent. Soc., 1: 98.—Cresson, 1872, Trans. Amer. Ent. Soc., 4: 203.—Dalla Torre, 1897, Cat. Hymen., VIII, p. 275.—Peckham & Peckham, 1900, Bull. Wisc. Nat. Hist. Soc., 1: 87. [Biology.]

Arachnophroctonus atrox Howard, 1901, The Insect Book, pl. VII, fig. 14.

Anoplius atrox J. Smith, 1910, Ann. Rpt. N. J. State Mus. 1909, p. 674.

Psammochares (*Lophopompilus*) *atrox* Banks, 1912, Jour. N. Y. Ent. Soc., 19: 224.—Rohwer, 1916, Conn. Geol. Nat. Hist. Survey Bull. 22, pp. 633-634.—Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 986.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 123.

Lophopompilus atrox Regan, 1923, Ann. Ent. Soc. Amer., 16: 178-191, pl. XI, fig. 2, pl. XII, figs. 4 & 6, & pl. XIII, figs. 1, 2, & 8.

Prior to Regan's work in 1923, this species and *bengtssoni* Regan were not separated; most of the earlier literature therefore actually refers to the two sibling species indiscriminately. The male genitalia differ considerably in these two species, but otherwise they are extremely similar, differing by such subtle characters as the degree of convergence of the eyes above, the depth of the clypeal emargination, the size of the ocelli, etc. The two species occur over much the same range and apparently in the same habitat.

FEMALE.—Length 20 (15-24) mm. Color black, the second abdominal tergite with a pair of large orange spots which may be confluent medially or separated by a thin black line. Wings wholly fuliginous, in fresh specimens violaceous. Pubescence dark, scarcely reflecting metallic colors; body with abundant erect hair.

Clypeus about 2.9 times as broad as high, the apical margin with a rather narrow, well-defined median emargination. Front of moderate breadth, the middle interocular distance varying from .56 to .62 times the transfacial distance; eyes converging slightly to the middle, then more strongly above, the middle interocular distance about .95 times the lower interocular, the upper interocular about .75 times the lower. Ocelli in a close triangle, the front angle about a right angle; postocellar line slightly less than ocello-ocular. First four antennal segments in a ratio of about 4:1:7:5, segment 3 subequal to or slightly greater than the upper interocular distance.

Pronotum arcuate behind; scutellum prominently convex; propodeum convex, with an ill-defined flattened posterior declivity. Front tarsus with a comb of spines which are about one and one-half times as long as the tarsus is thick; basitarsus with 3 comb-spines, the apical one slightly less than half as long as the second tarsal segment. Wing venation of the usual pattern in the subgenus; third submarginal cell narrowed by from half to three-fourths above.

MALE.—Length 16 (12-20) mm. Color of body and wings as in female; lower inner and upper outer orbits often with a very narrow, pale stripe. Pubescence very dark, in certain lights vaguely reflecting deep blue-green.

Body with abundant erect hair; scape hairy; coxae hairy, the femora often slightly so.

Clypeus from 2.1 to 2.4 times as broad as high, the apical margin very slightly concave. Middle interocular distance from .6 to .63 times the transfacial distance. Inner orbits converging above somewhat, the upper interocular distance from .88 to .95 times the lower interocular. Ocelli rather close together, of average size, forming a right angle or slightly greater in front; postocellar line usually slightly less than the ocello-ocular. First four antennal segments in a ratio of about 3:1:3.2:3, the third segment about 3 times as long as thick.

Pronotum moderately long, its posterior margin subarcuate or very feebly angulate. Slope of propodeum rather gradual in front, more steeply declivous behind. Abdominal sternite 6 with a large V-shaped emargination, the base of the emargination slit-like. Subgenital plate of the usual form in the subgenus, the basal process rather long, extending more than halfway from the basal sclerite to the apex of the plate (fig. 117). Genitalia (Fig. 76) with the parameres slender, with abundant strong setae on the outer margin and apex, the ventral surface setose on the outer third; digiti with the outer margins arcuate, the inner margins nearly straight, the disc covered with stout setae.

Biology.—The Peckhams (1900) found this species nesting in a crevice in a hillside; the prey was a large spider (not identified) which it carried backward to the nest. A female from Clifton, Va. [USNM] is pinned with a poorly preserved spider labeled as *Lycosa rabida* Walck. *A. atrox* occurs principally in fields and meadows, and has been taken on the flowers of *Daucus carota, Cicuta maculata, Pastinaca sativa, Conium maculatum, Melilotus alba,* and *Euphorbia marginata.* In the latitude of New York the flight season is during July and August, and there is but one generation a year; in the southern tier of states it occurs from May to October and undoubtedly has two or more generations a year.

Distribution.—This is principally an Austral species, but occurs in the lower fringes of the Transition zone, ranging from Florida, Texas, and New Mexico to Montana, Minnesota, southern Ontario, and Massachusetts.

Specimens seen: 137 (66 ♀♀, 71 ♂♂). The following records are marginal: MASSACHUSETTS: Hampshire Co., 1 ♀, 2 ♂♂, Amherst, July-Aug. [Mass.]; VERMONT: Windham Co., 1 ♂, Laurel Lake, Aug. [Mass.]; NEW YORK: Tompkins Co., 1 ♀, 2 ♂♂, Ithaca, 18 July-18 Aug. [CU]; ONTARIO: 2 ♂♂, Chatham, Aug. [CNC]; MICHIGAN: Ingham Co., 1 ♂, East Lansing, 30 Aug. [Coll. R. L. Fischer]; MINNESOTA: Olmstead Co., 1 ♀ [USNM]; SOUTH DAKOTA: Jackson Co., 1 ♀, Interior, 6 Aug. [SDS]; MONTANA:

(Recorded by Regan, 1923); COLORADO: Boulder Co., 1 ♀, Jim Creek, 8 July [AMNH]; NEW MEXICO: Sandoval Co., 1 ♂, Jemez Springs, 7 July [CU]; TEXAS: Montgomery Co., 1 ♀, Willis [USNM]; LOUISIANA: 1 ♀ [ANSP]; ALABAMA: Mobile Co., 1 ♂, Theodore, 12 June [CU]; FLORIDA: Marion Co., 1 ♀, Ocala, 6 Apr. [HEE].

5. **Anoplius (Lophopompilus) bengtssoni** (Regan) (Pl. XI, fig. 75.)

Lophopompilus bengtssoni Regan, 1923, Ann. Ent. Soc. Amer., 16: 178-191, pl. XI, fig. 1, pl. XII, fig. 5, & pl. XIII, figs. 3, 4, & 5. [Type: ♀; Dallas, Texas, "8-5" 1908, at night in lighted house (E. S. Tucker); U.S.N.M. no. 26, 691.]

Psammochares (*Lophopompilus*) *bengtssoni* Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 986. [L. I., N. Y.]—Johnson, 1930, List Insect Fauna Nantucket, p. 110.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 123. [Smiths Isl., N. C.]—Brimley, 1938, Insects No. Carolina, p. 433.

Anoplius (*Lophopompilus*) *bengtssoni* Krombein, 1950, Jour. Elisha Mitchell Sci. Soc., 65: 264.

This is the largest species of the subfamily Pompilinae in North America. It is easily confused with the preceding species, *atrox*, however, unless care is taken in observing the key characters.

FEMALE.—Length 22 (17-26) mm. Color black, the second abdominal tergite with a pair of large orange spots narrowly separated or confluent medially. Wings fuliginous, more or less violaceous. Pubescence fine, dark, velvety, in certain lights obscurely reflecting deep blue-green; body with abundant erect hair, the scape hairy, especially above, the femora often somewhat hairy.

Clypeus from 2.5 to 3 times as broad as high, the apical margin with a broad, shallow median emargination. Front rather narrow, the middle interocular distance about .55 times the transfacial; inner orbits converging strongly above, the middle interocular distance about .9 the lower interocular, the upper interocular only about .65 times the lower. Ocelli close together, the laterals distant from the median ocellus by less than the diameter of the latter; postocellar line nearly always slightly greater than the ocello-ocular. First four antennal segments in a ratio of about 4:1:7:5, segment 3 from 1.2 to 1.35 times the upper interocular distance.

Pronotum short, posterior margin arcuate; propodeum with the posterior slope nearly flat, obliquely declivous. Spines of tarsal comb about twice as long as the width of the tarsus; basitarsus nearly always with 4 comb-spines, the basal one usually smaller than the others. Fore wing with the third submarginal cell narrowed by usually about half above; third transverse cubital vein often with a slight sinuation or "kink".

MALE.—Length 17 (14-21) mm. Color of integument, wings, and pubescence as in the female, except that there are often thin pale lines on the lower inner and upper outer orbits. Body with the usual abundance or long, dark, erect hairs. Clypeus a little over twice as broad as high, its apical margin truncate. Middle interocular distance varying from .57 to .63 times the transfacial distance. Inner orbits converging considerably above, upper interocular distance from .80 to .88 times the lower. Ocelli rather large, about as in the female. First four antennal segments in a ratio of about 3:1:3.2:3, the third segment about three times as long as thick.

Posterior pronotal margin arcuate, usually with a faint median angulation; propodeum with an oblique, flattened declivity behind. Abdominal sternite 6 with a deep V-shaped emargination. Subgenital plate as in the two preceding species, the plumose process rather long. Genitalia (Fig. 75) characterized by the broad parameres, which are setose on the outer margin and apical third of the ventral surface. Digiti elongate-subfusiform, the inner margin straight or somewhat sinuate, the disc clothed with strong setae. Parapenials slender and elongate, subequal in length to the aedoeagus, but these structures slightly shorter than the parameres.

Biology.—This species is most commonly taken on flowers, and has been taken on *Cicuta maculata, Stillingia sylvatica, Melilotus alba, Ampelopsis arborea,* and *Solidago* spp. It also visits honeydew and has been taken at light. In the North it is a late summer species (mid-July to early October) with but one yearly generation, but in the South it occurs throughout the summer months (Apr.-Nov.).

Distribution.—This is essentially an Austroriparian and Carolinian species, ranging from Texas and Florida to South Dakota, Michigan, and Massachusetts.

Specimens seen: 85 (42 ♀♀, 43 ♂♂). The following records are marginal: MASSACHUSETTS: Dukes Co., 1 ♀, Martha's Vineyard, Sept. [CU]; Hampshire Co., 1 ♀, Cummington, Aug. [HEE]; NEW YORK: Suffolk Co., 1 ♀, Riverhead, 14 Sept. [CU]; PENNSYLVANIA: Dauphin Co., 1 ♀, Rockville, 5 July [ANSP]; Erie Co., 1 ♀, Presque Isle, 23 July [CM]; MICHIGAN: Cheboygan Co., 2 ♂♂, Douglas Lake, 23 Aug. [Minn.]; MINNESOTA: Goodhue Co., 1 ♀, Red Wing, 18 July [Minn.]; SOUTH DAKOTA: Jackson Co., 3 ♀♀, Interior, 5-6 Aug. [SDS]; NEBRASKA: Thomas Co., 1 ♀, Halsey, 31 Aug. [Minn.]; KANSAS: Cheyenne Co., 2 ♂♂ [UK]; TEXAS: Williamson Co., 1 ♂, 4 June [JEG]; ALABAMA: Mobile Co., 1 ♂, June [CU]; FLORIDA: DeSoto Co., 1 ♂, Arcadia, 10 Apr. [CU].

B. Subgenus **NOTIOCHARES** Banks

Notiochares Banks, 1917, Bull. Mus. Comp. Zool., 61: 107, 108. [Type: *Pompilus philadelphicus* Lepeletier, 1845 (=*amethystinus atramentarius*

Dahlbom, 1844); monobasic.] [Proposed as subgenus of *Psammochares.*] —Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 122-123.—Banks, 1939, Canad. Ent., 71: 225. [Genus.]—Banks, 1947, Bull. Mus. Comp. Zool., 99: 408-411. [South American species.]—Dreisbach, 1949, Ent. Amer., (n. s.) 29: 8, 9, 40, pl. IV, fig. 21.

The species assigned to this subgenus form a rather closely knit group clearly derived from stock similar to the subgenus *Arachnophroctonus.* The males have acquired a number of morphological specializations, such as the patch of velvety pubescence at the apex of the fourth abdominal sternite, the basally bilobed and apically forked subgenital plate, and the small flap-like lobes which replace the basal hooklets of the genitalia. The females, however, resemble very closely the members of the subgenus *Arachnophroctonus,* and are separable from them only by a combination of more subtle characters. The anterior margin of the clypeus is slightly to strongly emarginate; the body is never strongly hairy, the propodeum bearing at most a few weak setae; the pulvillar pad and comb are unusually well developed; the pronotum is always angulate behind; the radial vein of the fore wing is somewhat angled at the third transverse cubital, the third submarginal cell strongly narrowed above, but not triangular or petiolate.

Subgeneric characters.—Medium-sized or fairly large wasps (10-25 mm.); our species wholly black or blue-black, but some extralimital species marked with red and/or yellow; wings fuliginous. Scape without erect hairs; front and vertex varying from barely to moderately hairy; pronotum, scutellum, and propodeum barely or slightly hairy; metanotum with a small patch of short hairs on each side; abdominal sternites beyond the first each with some strong setae in both sexes; female pygidium densely bristly.

Mandibles with a single strong tooth on the inner margin subtended by a carina, some females with a weak second tooth basad of this. Labrum rounded or subtruncate apically, the margin bristly, usually almost wholly concealed by the clypeus. Clypeus wider than the lower front, its apical margin in the female at least arcuately concave, often distinctly emarginate, in the male truncate or slightly concave. Front relatively narrow, in the female seldom much wider than the two eyes taken together. Vertex narrow, and never raised above the tops of the eyes. Antennae elongate, segment 3 in the female never much shorter than the upper interocular distance, segment 3 in the male longer than 1 or 4.

Posterior margin of pronotum always distinctly angulate; postnotum a narrow transverse band, feebly transversely striate; propodeum with rather even contours, in the females and some males with a somewhat flattened declivity behind. Tarsal comb of female present, consisting of short spines, from 1 to 2 times as long as the width of the tarsus; basitarsus with 3 or 4 comb-spines and 3 or 4 additional spines in a row below these. Last segment of front tarsus of male not modified, the sides expanded evenly and gradually from the base, the inner claw of this tarsus deeply cleft, the inner ray short, blunt; remaining claws bifid, the inner ray somewhat truncate. Pulvillar pad rather large, setulae of pulvillar comb in a close, even series, numbering about 24 in the female, 18 in the male. Hind wing with the cubitus arising at or a little before the tip of the submedian cell. Basal of fore wing arising at or a little beyond (rarely before) the intersection of the transverse median with the media. Stigma short; marginal cell fairly long, about or a little less than its own length from the wing-tip, the radial vein always with a more or less distinct angulation at the third transverse cubital vein. Third submarginal cell much narrowed above, often subtriangular.

Abdomen of male rather stout, subfusiform. Fourth sternite in the male with a semicircular mat of dense, short, black pile along its posterior margin. Sixth sternite with a broadly U-shaped apical emargination. Subgenital plate (Fig. 118) at the base internally with a broad expansion on each side, at the apex of which is a small group of short, thick setae; apex of the plate with a sharply defined V-shaped emargination, on each side of which it is acutely pointed. Genitalia with the cardo very long; basal hooklets replaced by small, flap-like lobes; parameres with prominent squamae, beyond which these appendages are much more slender; aedoeagus simple, slightly expanded apically (Fig. 77).

Biology.—These wasps are commonly taken on flowers. They are hunters of large spiders of the family Lycosidae, and nest in the ground. Little is known of their habits, but a few notes are included under our common form, *A.* (*N.*) *amethystinus atramentarius* (Dahlbom).

Distribution.—This subgenus is confined to the Neotropical Region except for a single species, *amethystinus,* which enters the Austral portion of the Nearctic Region. In South America this group includes such well-known species as *insularis* Holmberg, *scalaris* Taschenberg, and *triquetrus* Fox, as well as the widely distributed *amethystinus* Fabricius.

Key to Subspecies

Females and Males

1. Body rendered by the pubescence a brilliant deep blue or blue-green; wings strongly bluish-refulgent

1a. amethystinus amethystinus (Fabr.)

Body rendered by the pubescence a dull deep violet or purplish, which in proper light vaguely reflects deep blue-green; wings violaceous
1b. **amethystinus atramentarius** (Dahlbom)

1a. **Anoplius (Notiochares) amethystinus amethystinus** (Fabricius) new combination[3] (Pl. XI, fig. 77; pl. XVIII, fig. 118.)

Sphex amethystina Fabricius, 1793, Ent. Syst. Emend. & Auct., II, p. 210. [Type: ♀?; St. Croix, West Indies (Dr. Pflug); (location not known to present author)].

Pompilus amethystinus Fabricius, 1798, Suppl. Ent. Syst., p. 247.—Smith, 1855, Cat. Hymen. Brit. Mus., III, p. 148. [Brazil, Guiana.]—Taschenberg, 1869, Zeitschr. Ges. Naturw., 34: 50. [Antilles, Colombia, Brazil.] —Dalla Torre, 1897, Cat. Hymen., VIII, p. 272.

Pepsis amethystina Fabricius, 1804, Syst. Piezatorum, p. 215.—Cresson, 1867, Trans. Amer. Ent. Soc., 1: 149.—Dalla Torre, 1897, Cat. Hymen., VIII, p. 246.

Pompilus anceps Cresson, 1865, Proc. Ent. Soc. Phila., 4: 130. [Lectotype: ♂; Cuba (no further data); A.N.S.P. no. 420.] [*Nec* Smith, 1862.] New synonymy.

Pompilus cubensis Cresson, 1867, Trans. Amer. Ent. Soc., 1: 93. [New name for *anceps* Cresson, preoccupied.] New synonymy.—Dalla Torre, 1897, Cat. Hymen., VIII, p. 283.—Gowdey, 1926, Jamaica Dept. Agri. Ent. Bull. no. 4, p. 96. [Jamaica.]

Pompilus philadelphicus var. *cubensis* Cresson, 1869, Proc. Boston Soc. Nat. Hist., 12: 366. [Orizaba, Mex.]

Psammochares philadelphicus var. *floridensis* Banks, 1917, Bull. Mus. Comp. Zool., 61: 106. [Type: ♀; Gulfport, Fla., Sept. (Reynolds); M.C.Z. no. 10,021.] New synonymy.

Notiochares philadelphicus Banks, 1925, Bull. M.C.Z., 67: 338. [Panama.]

Notiochares fulgidus Banks, 1928, Harvard Biol. Lab. Cuba (Atkins Found.), Studies in Cuban Insects, I, p. 9. [Cuba, Bahamas; *nec* Cresson; misidentification.]

Notiochares cubensis Bradley, 1946, Mem. Soc. Cubana Hist. Nat., 18: 130.

Notiochares amethystina Banks, 1947, Bull. Mus. Comp. Zool., 99: 410. [So. America, many records.]

This distinctive and showy wasp is possibly the most widely distributed of all American Pompilidae. I have been unable to find any constant differences between Cresson's *cubensis*, Banks' *floridensis*, and Fabricius' *amethystinus*.

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[3] This is a common wasp throughout much of the Neotropical Region; I have not attempted to present a complete list of references pertaining to extralimital records.

FEMALE.—Length 18 (14-22) mm. Integument black; pubescence dark, over most of the body brilliantly reflecting deep metallic blue or blue-green; wings fuliginous, conspicuously reflecting bluish or blue-green. Mandibles and clypeus with a few bristles; front and vertex with numerous erect hairs; propodeum very slightly, inconspicuously hairy.

Clypeus about 2.2 times as broad as high, its apical margin with a clearly defined median emargination. Front narrow, the middle interocular distance varying from .52 to .55 times the transfacial distance. Lower inner orbits subparallel; eyes converging somewhat above, the upper interocular distance varying from .75 to .88 times the lower interocular. Ocelli in a right triangle, the laterals about equidistant from each other and the nearest eye margin. First four antennal segments in a ratio of about 4:1:7:5, the third segment equal to from 1.1 to 1.25 times the upper interocular distance. Temples moderately developed, in lateral view somewhat more than half the width of the eye.

Front basitarsus with four comb-spines, the spines about 1.5 times the thickness of the tarsus, the apical one not more than half the length of the second tarsal segment, often somewhat less. Tibial spurs usually slightly curved apically. First abdominal tergite with a median linear impression at the top of the anterior slope.

MALE.—Length 14 (10-17) mm. Color of body and wings as in female; pubescence as in female, except that it is often more brownish on the legs, and often silvery or cinereous on the front. Clypeus about twice as broad as high, the apical margin slightly arcuately concave. Middle interocular distance varying from .57 to .6 times the transfacial distance. Middle interocular distance about 1.2 times the lower interocular; upper interocular distance about .9 times the lower. Ocelli about as in female. First four antennal segments in a ratio of about 8:2:9:8, the third segment more than three times as long as thick.

Slope of propodeum rather low and even, the median line lightly impressed. Apical tarsal segments with several median spines beneath. Abdomen with the subgenital plate (Fig. 118) with three carinae on the disc, one median, and a pair on the sides which diverge slightly apicad, none of them reaching the apex; basal lateral flanges of the subgenital plate prominent, acute, tipped with a small group of short setae. Genitalia (Fig. 77) rather variable; parameres very slender beyond the squamae, and bearing only a few setae here; digiti subspatulate, clothed with small setae; parapenials curved, stouter near the base than apically; aedoeagus much expanded apically, the apex broadly rounded or feebly bilobed.

Distribution.—This form ranges from Bolivia and northern Argentina north to Mexico and the Antilles. It barely enters the United States in the southern parts of Florida, Arizona, and California.

Specimens seen from the United States: 22 (14 ♀♀, 8 ♂♂). FLORIDA: Calhoun Co., 1 ♀, Blountstown, 14 Aug. [CU]; Collier Co., 1 ♀, Everglade, 5 Apr. [AMNH]; 2 ♀♀, 2 ♂♂, 10-40 mi. E. of Everglade, 30 Aug. [CU]; 1 ♀, Naples, 29 Aug. [CU]; Dade Co., 1 ♀, Homestead, Aug. [UK]; 2 ♀♀, 1 ♂, Royal Palm Park, Mch., July [ANSP, CU, UK]; 1 ♀, Paradise Key, 20 Apr. [USNM]; Orange Co., 1 ♀, Orlando [CU]; Pinellas Co., 1 ♀, Gulfport, Sept. [MCZ]; ARIZONA: Santa Cruz Co., 1 ♀, Nogales, 30 Aug. [CU]; CALIFORNIA: Imperial Co., 5 ♂♂, Experiment Farm, May-June [USNM]; 1 ♀, Westmoreland, 21 May [CIS]; Riverside Co., 1 ♀, Blythe, 3 Oct. [Minn.].

Specimens also seen from the following places south of the United States: Mexico (states of Baja California, Jalisco, Morelos, Sinaloa, and Vera Cruz), Guatemala, Costa Rica, Panama, Colombia, Ecuador, Peru, Bolivia, Argentina, Paraguay, Brazil, British Guiana, Venezuela, Trinidad, Barbados, Haiti, St. Vincent, Puerto Rico, Jamaica, and Cuba.

1b. **Anoplius (Notiochares) amethystinus atramentarius** (Dahlbom)

Pompilus atramentarius Dahlbom, 1844, Hymen. Europ., I, p. 48. [Type: ♂; North America (no further data); University of Lund, Sweden (not seen by present author).]—Dahlbom, 1845, Hymen. Eur., I, p. 446. —Cresson, 1867, Trans. Amer. Ent. Soc., 1: 90. [Not identified.]—Dalla Torre, 1897, Cat. Hymen., VIII, p. 274.

Pompilus philadelphicus Lepeletier, 1845, Hist. Nat. des Insectes, Hymen., III, p. 423. [Type: ♀; Philadelphia, Pa.; (location of type not known to present author).] New synonymy.—F. Smith, 1855, Cat. Hymen. Brit. Mus., III, p. 160.—Cresson, 1867, Trans. Amer. Ent. Soc., 1: 87. [Conn., Del., La.]—Cresson, 1872, Trans. Amer. Ent. Soc., 4: 202. [Texas.]—Provancher, 1882, Nat. Canad., 13: 35, 37.—Provancher, 1883, Nat. Canad., 14: 35. [Earlier record from Canada retracted.] —Dalla Torre, 1897, Cat. Hymen., VIII, p. 310.—Birkman, 1899, Ent. News, 10: 244. [Fedor, Texas.]—Howard, 1901, The Insect Book, pl. VII, fig. 19.

Pompilus philadelphicus var. *sericatus* Cresson, 1872, Trans. Amer. Ent. Soc. 4: 202. [Type: ♂; Dallas, Texas (Boll); A.N.S.P. no. 411.]—Dalla Torre, 1897, Cat. Hymen., VIII, p. 310.

Anoplius (Sophropompilus?) philadelphicus Viereck, 1906, Trans. Amer. Ent. Soc., 32: 223. [Galveston, Tex.]

Anoplius philadelphicus J. Smith, 1910, Ann. Rpt. N. J. State Mus. 1909, p. 674.

Sericopompilus plutonis Banks, 1912, Jour. N. Y. Ent. Soc., 19: 228. [Type: ♂; Fedor, Lee Co., Texas, 3 June 1904 (Birkmann); M.C.Z. no.

13,708.] New synonymy.—Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.

Psammochares philadelphicus Banks, 1912, Ent. News, 23: 108. [At flowers of *Ceanothus* in Va.]—Britton, 1920, Conn. Geol. Nat. Hist. Survey Bull. 31, p. 336.

Psammochares (*Lophopompilus*) *philadelphicus* Rohwer, 1916, Conn. Geol. Nat. Hist. Survey Bull. 22, p. 633, 634. [Conn.]

Psammochares (*Notiochares*) *philadelphicus* Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc. 52: 123. [N. C.]—Brimley, 1938, Insects No. Carolina, p. 433.

Notiochares philadelphicus Rau, 1922, Trans. Acad. Sci. St. Louis, v. 24, no. 7, pp. 13-15, & pl. VI, fig. 5. [Biology.]—Dreisbach, 1949, Ent. Amer., (n. s.) 29: 40, pl. IV, fig. 21.

Notiochares angusticeps Banks, 1939, Canad. Ent., 71: 227. [Type: ♀; Brownsville, Texas, 11-16 June 1933 (Darlington); M.C.Z. no. 23,477.] New synonymy.

Anoplius (*Notiochares*) *philadelphicus* Krombein, 1950, Jour. Elisha Mitchell Sci. Soc., 65: 264.

This is one of the commonest Pompilidae in the Austroriparian fauna, and not uncommon throughout much of the Carolinian. It has, however, rarely been called by its correct name. Dahlbom's description, which antedates Lepeletier's *philadelphicus* by a year, rather clearly applies to this species. Recently I have sent specimens of this form to the University of Lund, where Dr. Kjell Ander has been kind enough to compare them with the type of *atramentarius*. After a careful comparison, Dr. Ander assures me that what has been called *philadelphicus* is conspecific with Dahlbom's *atramentarius*.

FEMALE.—Length 19 (15-24) mm. Color black; pubescence over the greater part of the body dark, reflecting deep violet or purple, in certain lights obscurely reflecting deep blue-green; pubescence on the front, clypeus, and coxae (and sometimes much more of the body) more or less brownish or cinereous. Wings wholly fuliginous, violaceous. Morphological features virtually the same as in the nominate subspecies. In both forms there is a certain amount of variation in the sharpness of limitation and in the depth of the clypeal emargination, and also in the width of the front and vertex.

MALE.—Length 15 (12-19) mm. Color of body, pubescence, and wings as in the female. Structural characters, including those of the terminalia, not differing from those of typical *amethystinus*.

Biology.—This is a wide-ranging species which occurs in a variety of habitats, but seems to prefer bare, clay-soil areas, especially along water-courses. It is most frequently taken on flowers, and has been taken on the following: *Cicuta curtissii, Cicuta maculata, Conium maculatum, Bifora americana, Monarda* sp., *Solidago* spp., *Melilotus alba, Baccharis salicina, Tamarix* spp., *Verbesina helianthoides, Avicennia nitida, Ampelopsis arborea, Euphorbia marginata, Eupatorium* sp., *Polytaenia nuttallii,* and *Persicara lapathifolia.* The flight season extends from April to October throughout most of its range.

Rau (1922) reports several observations on this species. He found it preying upon *Lycosa scutulata* Emerton (=*rabida* Walck.), and also observed it attacking an orb-weaver in its web. He noticed this species "loitering" around its nest, a hole in the earth, which contained a larva which had partially consumed its spider. One would assume from this that this wasp does not close its burrow after provisioning; this would be an unusual trait for a Pompiline wasp, and I am not sure that I understand Rau correctly. Rau also observed a female emerging from the sand, awaited by four males. One of the males succeeded in mating with the female, while two more struggled to drag him off. "The mating", says Rau, "lasted for about a minute, when the female was . . . placed in the same vial [as one of the males], where the mating continued".

I have taken one specimen of *atramentarius* with its prey, a large but immature *Lycosa* [det. B. J. Kaston], which it was dragging by the end of a leg over the ground in a shaded area near a stream. On another occasion I observed a female of this form standing astride a spider on a sand-bank. I was able to approach closely, and noticed that the wasp seemed to be feeding on the spider. In a few moments the wasp flew off to another part of the sand-bank. The spider proved to be a male *Arctosa littoralis* (Hentz) [det. B. J. Kaston]; two legs had been cut off neatly at the base and two others mutilated. The wasp was watched and finally captured only after I was convinced she did not intend to return to the spider, and was not using it to provision a nest. The spider was very small for a wasp of this size. It seems likely that either she had captured this spider merely for feeding purposes, or had "decided" after capturing it that it was not of sufficient size for provisioning a nest, and hence was feeding upon it herself.

These few notes suggest that this may be a rather versatile wasp, and leave one with the hope that we may soon learn more of its habits.

Distribution.—This form ranges from western and southern Texas and central Florida north to Nebraska, Ohio, and, east of the Appalachians, southeastern New York and perhaps Connecticut.

Specimens seen: 641 (385 ♀♀, 256 ♂♂). The following records appear to be marginal: CONNECTICUT: (recorded by Rohwer, 1916); NEW YORK: Kings Co., 1 ♂, Brooklyn, 18 July [coll. L. Schatz]; NEW JERSEY: Burlington Co., 1 ♂, Medford Lake [ANSP]; PENNSYLVANIA: Philadelphia, 1 ♀, 5 ♂♂ [ANSP, CU]; York Co., 1 ♂, York, 1 Sept. [ANSP]; Allegheny Co., 1 ♀ [CM]; OHIO: Greene Co., 1 ♀, Clifton, 19 Aug. [RWS]; INDIANA: Knox Co., 2 ♀♀, Vincennes, 29 May [USNM]; NEBRASKA: Otoe Co., 1 ♀, Nebraska City, 23 July [CAS]; KANSAS: Meade Co., 4 ♀♀, 2 ♂♂ [UK]; OKLAHOMA: Comanche Co., 1 ♀, Lawton, 20 Mch. [USNM]; TEXAS: Reeves Co., 1 ♀, 2 ♂♂, Balmorhea Lake, 18 July [HEE]; Cameron Co., 10 ♀♀, 5 ♂♂, Port Isabel, 20-23 June [HEE, ANSP]; LOUISIANA: Cameron Co., 1 ♂, Cameron, June [UK]; ALABAMA: Mobile Co., 1 ♀, 10 Aug. [CU]; FLORIDA: Highlands Co., 1 ♀, Lake Placid, 15 Apr. [CU].

C. Subgenus **ANOPLIODES** Banks

Anopliodes Banks, 1939, Canad. Ent., 71: 225-226. [Type: *Anopliodes modestus* Banks, 1939 (=*bolli* Banks, 1917); monobasic.]

Anoplioides Dreisbach, 1949, Ent. Amer., (n. s.) 29: 7. [*Lapsus calami* for *Anopliodes* Banks.]

This is a small group of apparently uncommon species showing relationships both to *Notiochares* and to *Arachnophroctonus*. As in the former, the last segment of the front tarsus of the male is unmodified, the basal hooklets of the genitalia are wanting, and the front of the female is rather narrow. On the other hand, the fourth and seventh sternites of the male abdomen lack the modifications of *Notiochares*. The unique features of this group lie in the venation: the marginal cell is very long, the radial vein evenly arcuate, and the third submarginal cell wider above than the second, at least in the female.

Subgeneric characters.—Size 10-19 mm.; color black, the males sometimes marked with yellowish on the posterior pronotal margin, the scape, and the mandibles. Pubescence of females known to me more or less fuscous, not strongly reflecting metallic colors; males always with a considerable amount of silvery pubescence, sometimes highly ornamented with silvery. Front and vertex slightly to moderately hairy; thorax, propodeum, and first abdominal tergite with a variable amount of fine erect hair; female pygidium strongly bristly; propodeum of male with numerous white erect hairs; venter of male somewhat hairy, often with thin to dense brushes of hair on some of the sternites.

Mandibles with a single strong tooth on the inner margin, the female usually with some evidence of a weak second tooth basad of this. Apical margin of clypeus truncate or slightly arcuately concave. Front of female narrow, the middle interocular distance never over .55 times the transfacial distance. Temples but slightly developed in the female, scarcely at all so in the male. Antennae elongate, segment 3 in the female at least 1.2 times the upper interocular distance.

Postnotum a narrow transverse band, in the male a little wider near the mid-line than on the sides. Propodeum of female with a well-defined oblique, more or less flat declivity behind, that of the male rather long and with the slope very low. Tarsal comb of female consisting of short spines which are not or but little longer than the width of the tarsal segments; there are 3 comb-spines on the basitarsus, the apical one very short and not one third the length of the second segment; in addition there are three more, usually slightly longer spines in a row below these. Last segment of front tarsus of male not modified, the inner margin not produced, the inner claw of this tarsus strongly curved, deeply cleft, the inner ray short and blunt. Pulvillar pad of moderate size, the comb consisting of fairly long setae, numbering 16-24 in the female, about 10 in the male. Legs of male strongly spinose, the middle and hind tibiae grooved beneath each spine.

Cubitus of hind wing arising at or a little before the tip of the submedian cell. Transverse median vein of fore wing meeting the media at or a little basad of the origin of the basal vein. Stigma very short, only a little longer than high. Marginal cell long, about or less than its own length from the wing-tip, the radial vein nearly evenly arcuate, but in some males somewhat angled at the third transverse cubital vein. Second and third submarginal cells both 4-sided, the third usually larger than the second and wider on the radial vein, but not so in some males. The wings of the male show some tendency to fold longitudinally.

Abdomen of male rather slender, the dorsum slightly flattened. Subgenital plate simple, its median line elevated, the apex more or less rounded. Male genitalia with the basal hooklets wanting, replaced by very slender, flap-like sclerites; basis volsellaris with a number of strong setae, the digitus subspatulate, more or less setose; parameres, parapenials, and aedoeagus elongate. Further generalizations regarding the genitalia are scarcely possible, as there are marked differences in the various species, the appendages sometimes being rather curiously modified.

Distribution.—This subgenus is principally Neotropical, a single species, *bolli* Banks, entering the Nearctic region, and another species, *parsonsi* Banks, entering the United States at the southern tip of Florida. Specimens before me from northern South America, determined by Banks as *Anoplius varius* Fabricius and *Psammochares ornamenta* Fox, belong to this group. All of the species seem to be uncommon, and nothing is known of their biology.

Key to Species

Females

1. Pronotum arcuate behind, with a slight angulation on the median line; propodeum with a considerable amount of very fine hair 1. **parsonsi** (Banks)

Pronotum broadly angulate behind; propodeum with only a small amount of very fine, inconspicuous hair ....2. **bolli** Banks

Males

1. Venter with numerous erect hairs, a little more dense on sternite 4, but not forming a dense brush; parameres of genitalia slender, nearly linear 1. **parsonsi** (Banks)

Venter with a very dense brush of erect hairs on sternite 4; parameres very broad basally ....2. **bolli** Banks

1. **Anoplius (Anopliodes) parsonsi** (Banks) new combination (Pl. XII, fig. 79.)

Psammochares parsonsi Banks, 1944, Bull. Mus. Comp. Zool., 94: 183-184. [Type: ♀; Buenos Aires, Trinidad Mts., Cuba, 17-23 June 1923 (C. T. Parsons); M.C.Z. no. 25,742.]

This species is known to me from only twelve specimens, four from Cuba and eight from southern Florida. It closely resembles *bolli*, but may be distinguished by the characters used in the key.

FEMALE.—Length 15 mm.; color black; wings rather heavily infuscated, slightly darker along the outer margin, violaceous. Pubescence mostly brownish-fuscous, a little paler on the coxae, clypeus, lower front, and sides of the metanotum, sometimes a bit silvery in these places. Pronotum slightly hairy; propodeum with a considerable amount of rather fine erect hair, especially dorso-laterally.

Clypeus 2.3 times as broad as high, the apical margin slightly concave. Front very narrow, the middle interocular distance only about .51 times the transfacial. Inner orbits subparallel below, convergent above, upper interocular distance equal to about .7 times the lower interocular. First four antennal segments in a ratio of about 7:2:12:9, segment three equal to about 1.35 times the upper interocular distance. Ocelli in a small triangle, the laterals distant from the median ocellus by less than the diameter of the latter, the angle formed by the ocelli in front somewhat less than a right angle; postocellar line slightly greater than the ocello-ocular.

Pronotum short, its posterior margin broadly arcuate, but with an ill-defined median angulation. Median line of propodeum vaguely impressed above. Marginal cell of fore wing about three times as long as high, approximately its own length from the wing-tip; third submarginal cell wider above and below than the second, narrowed by less than half above.

MALE.—Length 10.5 (10-11) mm.; color black, the posterior margin of the pronotum with a pale yellow stripe. Wings subhyaline, the veins brown, the fore wing more or less infuscated along the outer margin and through the marginal and outer submarginal cells, the apex of the hind wing infuscated. Pubescence more or less brownish, replaced by silvery as follows: sides of clypeus, lower front, temples, coxae and sometimes more of the legs, mesopleura, pronotum, posterior border of mesonotum, scutellum on the sides, metanotum, at least the anterior margin and posterior third of the propodeum, basal bands on abdominal tergites 1 to 3, and median apical spots on tergites 5 to 7. Front and vertex with numerous dark hairs; temples and propleura with abundant whitish hair; thorax, propodeum, and first abdominal tergite with a variable amount of fine, mostly pale hair, rather prominent on the posterior slope of the propodeum; abdominal sternites 2 to 5 each with a number of rather long, dark setae, slightly more abundant on sternite 4; apical two sternites somewhat hirsute.

Clypeus about twice as broad as high, truncate apically. Middle interocular distance varying from .61 to .64 times the transfacial distance; upper interocular distance about .9 times the lower interocular. First four antennal segments in a ratio of about 3:1:3:3, segment 3 about 2.4 times as long as thick. Ocelli forming a right or obtuse angle in front; posterior ocelli close to the vertex crest, which is rather abrupt, the head rather flat behind. Posterior pronotal margin broadly subangulate or nearly arcuate. Propodeum long, narrowed behind, its median line not impressed. Pubescence on the spurs and tarsi rather coarse; longer spur of hind tibia nearly as long as the basitarsus. Venation as in the female; third submarginal cell sometimes narrowed by slightly more than half above, but in the specimens seen by the writer it is always wider both above and below than the second.

Abdomen setose below as described above, but without dense brushes of hair. Sternite 6 with the emargination shallow, broadly U-shaped. Subgenital plate with the median line strongly elevated, the apex narrowly rounded. Genitalia (Fig. 79) with the parameres only a little wider at the base than apically, long and attenuate, strongly setose. Digiti clothed with short setae except along the outer margin, where they are much longer and somewhat sinuate. Parapenials simple, slightly curved, shorter than the aedoeagus, which is large, the apex bilobed. In some specimens the parameres considerably exceed the aedoeagus, instead of being subequal to it as in the one figured.

Distribution.—This species is known only from Cuba and extreme southern Florida, and is hence not truly a member of the Nearctic fauna. Only the males have thus far been taken in Florida.

Specimens seen: 12 (3 ♀♀, 9 ♂♂). FLORIDA: Dade Co., 1 ♂, Larkins, June [MCZ]; 1 ♂, Miami, 14 Sept. (Graenicher) [MCZ]; 2 ♂♂, Paradise Key, on lodge veranda, 8 Sept. 1918 (C. A. Mosier) [USNM]; 2 ♂♂, Paradise Key, 1 Apr. 1919 (C. A. Mosier) [USNM]; 2 ♂♂, Royal Palm Park (Mosier, Beamer) [USNM, MCZ]; CUBA, 1 ♂, Santiago de Cuba [MCZ]; 2 ♀♀, Buenos Aires, Trinidad Mts., 17-23 June 1923 (C. T. Parsons) [MCZ]; 1 ♀, San Vincente, Punta del Rio, 7 July 1940 (J. C. Bradley) [CU].

2. **Anoplius (Anopliodes) bolli** Banks (Pl. XII, fig. 78).

Anoplius bolli Banks, 1917, Bull. Mus. Comp. Zool., 61: 104. [Type: ♂; Dallas, Texas (Boll); M.C.Z. no. 10,017.]

Anopliodes modestus Banks, 1939, Canad. Ent., 71: 226. [Type: ♀; Brownsville, Texas, 11-16 June 1933 (Darlington); M.C.Z. no. 23,476.] New synonymy.

Anoplius dolli [*sic*] Dreisbach, 1950, Amer. Midl. Nat., 43: 583.

This distinctive but uncommon species is not easily confused with any other. The male is ornamented with silvery pubescence and bears a dense brush of hairs on the fourth abdominal sternite. The female superficially resembles *A.* (*Arachnophroctonus*) *relativus* (Fox), but is readily told by the characters which separate these two subgenera.

FEMALE.—Length 15 (13-18.5) mm. Color black; wings rather heavily infuscated, with a darker marginal band, violaceous. Pubescence brownish-fuscous, a little paler on the clypeus, front, and coxae, very dark on the abdomen and often obscurely reflecting deep bluish or purplish. Pronotum slightly hairy; propodeum with very fine, short hairs, visible only on close examination.

Clypeus from 2.3 to 2.5 times as broad as high, its apical margin slightly concave. Middle interocular distance about .53 times the transfacial, the front thus very narrow. Inner orbits subparallel below, convergent above, the upper interocular distance about .75 times the lower interocular. First four antennal segments in a ratio of about 8:2:15:10, segment 3 equal to from 1.2 to 1.4 times the upper interocular distance. Ocelli in a close triangle, the front angle a right angle or a little less, postocellar line subequal to or slightly greater than the ocello-ocular line.

Pronotum short, its posterior margin broadly angulate. Median line of propodeum weakly impressed. Marginal cell of fore wing about three times as long as high; third submarginal cell in all the specimens seen wider above and below than the second.

MALE.—Length 11.5 (11-12) mm. Color black, the posterior pronotal margin with a very narrow pale stripe, the scape sometimes with pale markings. Wings subhyaline; the outer margin of the fore wing with a fuscous band which extends over the marginal cell and to some extent the outer submarginals; apex of hind wing infuscated. Pubescence in considerable part dark, showing some tendency to reflect deep metallic colors, but replaced by silvery pubescence as follows: base of mandibles, clypeus, lower front, temples, coxae, pronotum at least in large part, posterior part of mesonotum, scutellum at least on the sides, metanotum, posterior slope and rim of propodeum, much or all of the mesopleura, often extreme top and bottom of metapleura, basal bands on abdominal tergites 1-3, and median apical spots on tergites 4-7. Head, thorax, propodeum, and basal abdominal tergite with pale erect hair, most noticeable on the front, temples, and propodeum. Abdominal sternites 2 and 3 with a few weak hairs; sternite 4 posteriorly with a very dense brush of hairs, longer in front than behind; sternite 5 slightly hirsute posteriorly.

Clypeus about twice as broad as long, its apical margin truncate. Middle interocular distance .6 to .63 times the transfacial distance; inner orbits very slightly convergent above, the upper interocular distance about .95 times the lower interocular. First 4 antennal segments in a ratio of about 3:1:3:3, segment 3 about 2.4 times as long as thick. Ocelli in approximately a right triangle, the lateral ocelli close to the vertex crest and about as close to one another as to the nearest eye-margin. Posterior pronotal margin broadly angulate or subangulate. Fore wing with the radial vein arcuate or slightly angled; third submarginal cell narrowed by half to three fourths above, sometimes narrowed above more strongly than the second submarginal.

Abdomen slender, though slightly less so than in *parsonsi*; fourth sternite with a dense brush of hairs as described above. Sternite 6 with a narrow emargination apically. Subgenital plate strongly elevated medially, the apex rounded. Genitalia (Fig. 78) characterized by having the parameres much broadened near the base, the broad portion ventrally covered with short setae; beyond this are many long setae, some of which are clubbed; the paramere then tapers to an acute apex, the shaft clothed with numerous rather long setae. Digitus subspatulate, clothed with short setae; parapenials simple, very slightly curved; aedoeagus broadened apically, the margins somewhat ragged, the apex weakly bilobed.

Biology.—On several occasions I have taken the female of this species on riverbanks, flying over the ground. In every case the soil was clay, and not particularly sandy. Males have been taken on cotton and on the flowers of poison hemlock (*Conium maculatum*).

Distribution.—This species occurs locally throughout the Austroriparian and Carolinian faunas, from Texas and North Carolina to Kansas, Missouri, Pennsylvania, and New Jersey.

Specimens seen: 26 (19 ♀♀, 7 ♂♂). NEW JERSEY: Camden Co., 1 ♀ [USNM]; PENNSYLVANIA: Pike Co., 1 ♀, Paupack [KVK]; DISTRICT OF COLUMBIA: 1 ♀, Washington, 10 Sept. [USNM]; VIRGINIA: Fairfax Co., 1 ♀, Dunn Loring, 12 Aug. [HEE]; 1 ♀, Falls Church, 15 Sept. [HEE]; NORTH CAROLINA: Duplin Co., 2 ♂♂, Wallace, 17 June [Coll. H. K. Townes]; MISSOURI: 1 ♀, 1 ♂, St. Louis [USNM]; KANSAS: Crawford Co., 1 ♀, 5 Aug. [HEE]; Riley Co., 5 ♀♀, 1 ♂, Manhattan, 25 June, 17 Sept.-1 Oct. [HEE, KSC]; 1 ♀, Randolph, 21 Aug. [HEE]; TEXAS: Cameron Co., 1 ♀, 1 ♂, Brownsville, 11 June-2 July [MCZ, USNM]; Comal Co., 1 ♀, New Braunfels, 29 June [HEE]; Dallas Co., 1 ♂, Dallas [MCZ]; Hidalgo Co., 2 ♀♀, 23-25 June [HEE]; Jefferson Co., 1 ♀, Port Arthur, May [MCZ]; Liberty Co., 1 ♀, Dayton, 22 June [MCZ]; Victoria Co., 1 ♂, Victoria, 22 March [USNM].

D. Subgenus **ARACHNOPHROCTONUS** Howard

Arachnophroctonus Howard, 1901, The Insect Book, pl. VII, figs. 11 & 14. [Type: *Sphex tropica* Fabricius, 1775, *nec* Linnaeus, 1758 (= *marginalis* Banks, 1910); designated by Pate, 1946.]—Pate, 1946, Trans. Amer. Ent. Soc., 72: 129.

Arachnophila Ashmead, 1902, Canad. Ent., 34: 86. [*Nec* Salvadori, 1874, *nec* Haeckel, 1887.] [Type: *Pompilus divisus* Cresson, 1867 (= *semirufus* Cresson, 1867); monobasic.] New synonymy.

Psammochares Banks, 1912, Jour. N. Y. Ent. Soc., 19: 224. [In part.] —Banks, 1917, Bull. Mus. Comp. Zool., 61: 107, 108. [In part.]—Banks, 1919, Bull. Mus. Comp. Zool., 63: 231. [In part.]—Banks, 1939, Canad. Ent., 71: 226. [In part.]—Dreisbach, 1949, Ent. Amer., (n. s.) 29: 8, 10, 36, pl. II, fig. 7.

Arachnodaïcter Pate, 1946, Trans. Amer. Ent. Soc., 72: 74. [New name for *Arachnophila* Ashmead, preoccupied.] New synonymy.

The name *Arachnophroctonus* has unfortunately been used incorrectly by most authors. Ashmead in 1902 designated *ferrugineus* Say as the type; this species properly belongs in the genus *Tachypompilus* Ashmead, as I have indicated earlier [4]. The first use of the name *Arachnophroctonus* was by Howard, 1901, who included two species in the genus, *tropicus* Fabricius and *atrox* Dahlbom; the former has been designated type by Pate, 1946, thus assigning the name to the present group.

The species of this subgenus show somewhat greater variability, both interspecific and intraspecific, than is shown by the other five subgenera of *Anoplius*. They are also, by and large, more generalized. It is possible that the other subgenera arose, perhaps each separately, as developments of single lines from the more protean *Arachnophroctonus*. One invariable and very useful character in this group is the fact that the transverse median and basal veins of the fore wing are either interstitial, or the former meets the media slightly before the basal.

Subgeneric characters.—Small to fairly large wasps, 6 to 25 mm. in length. Nearctic forms mostly or wholly black, some species with the abdomen partly or entirely rufous, the males of some species with a pale stripe along the posterior pronotal margin. Propodeum with or without erect hairs; venter of male often with erect hairs, occasionally with dense brushes of hair on some of the sternites; pygidium of female varying from only slightly to very densely bristly.

Mandibles of male unidentate, those of the female usually bidentate, but the inner tooth sometimes weak or even wanting through wear. Apical margin of clypeus truncate, concave, or in one species emarginate. Front of very variable breadth. Antennae elongate, segment 3 in the female always longer than 1 or 4, segment 3 in the male at least twice as long as thick. Metapostnotum a narrow transverse band, at most about half the length of the metanotum. Tarsal comb of female present, the spines from 1 to 3.5 times as long as the thickness of the tarsus, the basitarsus with 3 or 4 (rarely 5) comb-spines. Last segment of front tarsus of males slightly asymmetrical, the inner margin feebly lobed, the segment widest about two-thirds the distance from the base (in some exotics apparently belonging here, this segment is unmodified); inner claw of front tarsus deeply cleft, strongly curved, the inner ray subacute, of moderate length. Pulvillar pad of moderate size, the comb fairly long, consisting of from 12 to 24 setulae in the female, 8 to 16 in the male.

Cubitus of hind wing arising at or a little beyond or before the tip of the submedian cell. Fore wing with the transverse median vein usually meeting the media at the origin of the basal, occasionally slightly before, rarely slightly beyond. Marginal cell about or somewhat more than its own length from the wing-tip; radial vein always somewhat angulate at the second or third transverse cubital vein. Second submarginal cell 4-sided; third submarginal cell much narrowed above, 4-sided or 3-sided, occasionally petiolate.

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[4] Evans, H. E., 1950, Trans. Amer. Ent. Soc., 75: 254.

Abdomen of male cylindrical or somewhat flattened above, varying from circular to subtrigonal in cross-section. Subgenital plate of simple form, without any special modifications, flat or with the median line somewhat elevated. Genitalia of rather uniform character, but possessing distinct specific differences; parameres always slender, nearly linear; basal hooklets single, strong; digiti spindle-shaped, the disc clothed with setae of variable nature; parapenials and aedoeagus simple.

Biology.—The species of this group inhabit open country, particularly where the soil is sandy; some of the species come frequently to flowers, while others practically never do. The nest is a simple burrow in the earth, usually in sand or clay, with a single terminal cell. So far as known, the species are not selective of their prey, but take primarily spiders of the families Lycosidae, Salticidae, Agelenidae, and Thomisidae.

Distribution.—This subgenus is widely distributed and well represented in the warmer regions of the globe. Numerous Neotropical species belong here, and I have seen several Ethiopian and Oriental species assignable to this group. The eight species of the Nearctic fauna fall into three rather well-defined species-groups.

Key to Species

Females

1. Wings wholly deep fuliginous, violaceous; propodeum often somewhat hairy; clypeus sometimes emarginate; propodeum with a rather well-defined flattened or slightly concave posterior declivity (*Marginalis*-group) 2

   Wings varying from hyaline to moderately heavily infuscated, with a darker marginal band, at least the hind wings subhyaline basally; propodeum not noticeably hairy, except when the entire body is unusually hairy; clypeus not emarginate; propodeum with the declivity not or only indistinctly defined 5

2. Clypeus somewhat elevated, its apical margin with a distinct median emargination; propodeum practically without erect hair; posterior margin of pronotum arcuate ....1. **bellicosus** (Banks)

   Clypeus scarcely elevated, its apical margin at most slightly arcuately concave; propodeum with at least some short hair 3

3. Head broadly oval, the front and vertex unusually broad; inner orbits diverging above, the upper interocular distance greater than the lower;

propodeum with a short, steep declivity, on the sides of which it is somewhat protuberant ....3. **xerophilus** Evans

Head not of unusual breadth; inner orbits converging above, the upper interocular distance less than the lower interocular; propodeal declivity more oblique, its lateral angles not prominent 4

4. Wholly black; antennae fairly long, segment 3 equal to from .65 to .95 times the upper interocular distance; front basitarsus with 3 comb-spines; postocellar line about equal to the ocello-ocular line 2. **relativus** (Fox)

Orange markings on second abdominal tergite (and sometimes more of the abdomen); antennae short for the genus, segment 3 equal to from .55 to .70 times the upper interocular distance; front basitarsus with from 3 to 5 (usually 4) comb-spines; postocellar line shorter than the ocello-ocular ....4. **marginalis** (Banks)

5. Spines of the tarsal comb long, at least 1.5 times as long as the thickness of the tarsus, the spine at the apex of the basitarsus well over half the length of the second tarsal segment; propodeum with a strong median linear impression; first abdominal tergite with a median basal sulcus (*Apiculatus*-group) 6

Comb-spines very short, but little if any longer than the thickness of the tarsus, the one at the apex of the basitarsus not over one third the length of the second tarsal segment; propodeum and first abdominal tergite lightly if at all impressed (*Americanus*-group)[5] 9

6. Mesosternum with small spiniform processes which project over the inner bases of the middle coxae; front broad, the middle interocular distance over .6 the transfacial distance; abdomen shining 6. **semirufus** (Cresson)

Mesosternum with processes short and broad, not spiniform; front more narrow, the middle interocular distance from .53 to .58 times the transfacial distance; abdomen not strongly shining 7

7. Abdomen wholly rufous except sometimes the apical one or two segments; Central America to the southern parts of California, Arizona, and Texas ....5a. **apiculatus apiculatus** (Smith)

Abdomen with only the basal three (rarely four) segments rufous; eastern Texas and Florida to Minnesota and Maine 8

8. Head and thorax extensively silvery-sericeous, the posterior margin of the pronotum with a distinct silvery band; mesopleura silvery-sericeous; Texas and Florida to Kansas, Minnesota, Ontario, and western New York ....5b. **apiculatus autumnalis** (Banks)

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[5] Certain species belonging to the *Subcylindricus*-group of the subgenus *Pompilinus* will occasionally key out to this group. These are separable by the small size and much broader front (the middle interocular distance always exceeding .6 times the transfacial). In the *Americanus*-group the front is very narrow, the middle interocular distance not exceeding .56 times the transfacial.

Silvery pubescence much reduced, and not forming a complete band on the posterior pronotal margin; mesopleura not or in small part silvery; Atlantic coastal plain, Florida to Maine
5c. **apiculatus pretiosus** (Banks)

9. Wholly black; posterior margin of pronotum very broadly angulate
8. **moestus** (Banks)

Abdomen marked with orange; angulation of pronotum somewhat more sharp 10

10. Abdominal tergites 2 and 3 with paired orange spots, separated by a thin line or more or less confluent medially, the abdomen otherwise black; eastern Texas, Tennessee, and North Carolina to South Dakota, Michigan, Ontario, and New Jersey
7a. **americanus americanus** (Beauv.)

Abdomen with a greater amount of rufous or orange coloration, the first tergite at least in part colored; Tropical and Lower Austral Zones 11

11. Posterior portion of first abdominal tergite, all of the second, and the anterior part of the third orange-brown; sternites wholly black; darker insects, usually without any silvery pubescence; average size somewhat larger; Georgia and Florida . ...7b. **americanus trifasciatus** (Beauv.)

Greater part of the first three abdominal tergites, and usually part or all of the sternites, more or less bright orange; at least the lower front usually silvery-sericeous; average size smaller; Central America and the Antilles to Alabama, Kansas, Utah, and California
7c. **americanus juxtus** (Cresson)

Males

1. Propodeum with a variable amount of dark erect hair; wings in general more heavily infuscated; hind femora strongly compressed; second and third transverse cubital veins usually not meeting above, the third submarginal cell 4-sided or subtriangular, rarely triangular or petiolate (*Marginalis*-group) 2

Propodeum without erect hairs, or with only a few pale hairs; wings hyaline or subhyaline, with a fuscous marginal band; third submarginal cell usually triangular, often petiolate 5

2. Abdominal sternites 4 and 5 with dense brushes of erect hairs (Fig. 146); digiti of genitalia with a group of very long, clubbed hairs on the disc
2. **relativus** (Fox)

Venter not more than slightly hairy; digiti without long clubbed hairs 3

3. Propodeal declivity almost vertical, its sides somewhat protuberant; vertex very broad, the upper interocular distance about 1.2 times the lower interocular; subgenital plate without long hairs along its median line or its outer margin ....3. **xerophilus** Evans

Propodeal declivity less abrupt, its sides not prominent; vertex less broad, the upper interocular distance at most 1.15 times the lower; subgenital plate with a series of erect hairs either along its median line or as an outer marginal fringe 4

4. Second abdominal tergite, and sometimes more of the abdomen, marked with orange; subgenital plate broad and nearly flat, its outer margin fringed with curved hairs; scape hairy ....4. **marginalis** (Banks)

Wholly black or blue-black; subgenital plate with the median line elevated and provided with a series of erect hairs, the margin not hairy; scape not hairy ....1. **bellicosus** (Banks)

5. Almost the entire body clothed with a coarse silvery or somewhat glaucous pubescence; clypeus at least 2¼ times as broad as high; venter without erect hairs; apex of digiti devoid of setae (*Apiculatus*-group) 6

Pubescence of the body very fine and delicate, though often in large part silvery; clypeus about twice as broad as high; venter with at least a few erect hairs; digiti setose to the apex (*Americanus*-group) [6] 7

6. Antennae rather heavy, segment 3 less than 2.5 times as long as its greatest thickness; subgenital plate rounded apically (Fig. 119)
5. **apiculatus** (Smith) [7]

Antennae more slender, segment 3 more than 2.5 times as long as thick; subgenital plate pointed apically (Fig. 120) ...6. **semirufus** (Cresson)

7. Subgenital plate clothed with perpendicular setae of moderate length (Fig. 122); digiti clothed with hairs of moderate length which are angled at their apices (Fig. 86) ....8. **moestus** (Banks)

Subgenital plate broadly rounded apically, clothed with fine pubescence and only a few setae if any (Fig. 121); digiti fringed with very long setae (Fig. 85) 8

8. Abdomen black, or the second tergite with a pair of small orange spots, the segment rarely encircled with orange; venter sparsely hairy; eastern Texas, Tennessee, and North Carolina to South Dakota, Michigan, Ontario, and New Jersey ....7a. **americanus americanus** (Beauv.)

Abdomen very rarely wholly black, the second segment usually marked with orange and usually encircled with orange, the coloration sometimes extending to adjacent segments; venter sparsely or conspicuously hairy; Tropical and Lower Austral Zones 9

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[6] Some members of the *Subcylindricus*-group of the subgenus *Pompilinus* will occasionally key out here. These may be recognized by their very small size, the absence of any scattered, long, erect setae on the venter, and the presence of a brush of very short hairs on the fourth sternite.

[7] This species is divisible into three subspecies on the basis of characters present (so far as I have been able to determine) in the female sex only. The user of the key is referred to couplets 7 and 8 of the key to females, where the ranges of the three subspecies are stated.

9. Georgia and Florida; a form averaging somewhat larger and darker than the others, but not clearly distinguishable in this sex
   - 7b. **americanus trifasciatus** (Beauv.)

   Central America and the Antilles to Alabama, Kansas, Utah, and California; abdomen conspicuously marked with bright orange; venter often conspicuously hairy ....7c. **americanus juxtus** (Cresson)

Marginalis Species-group

To this group are assigned four rather large, dark species, the pubescence in large part or wholly dark, often reflecting deep metallic colors, and the wings (except in the male *xerophilus*) wholly and rather uniformly fuliginous, violaceous. In general there is more erect hair on the body than in the other two species-groups; the tarsal comb is of moderate length, the spines between 1 and 2 times the width of the tarsus; the propodeum is rather convex and possesses a rather distinct posterior declivity; the femora of the male are strongly compressed; the abdomen of the male is somewhat flattened above; the third submarginal is only occasionally triangular, but often nearly so.

1. **Anoplius (Arachnophroctonus) bellicosus** (Banks) new combination (Pl. XII, fig. 80.)

Psammochares bellicosus Banks, 1912, Jour. N. Y. Ent. Soc., 19: 224. [Type: ♂; Palmerlee, Ariz., Sept.; M.C.Z. no. 13,666.]—Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—[not] Banks, 1919, Bull. Mus. Comp. Zool., 63: 233. [Calif., Wash.; based on misidentification.]—Regan, 1923, Ann. Ent. Soc. Amer., 16: 179.

Lophopompilus autilone Banks, 1919, Canad. Ent., 51: 82. [Type: ♂; Fort Myers, Fla., 7 May 1916 (J. C. Bradley); C. U. no. 679.]

Lophopompilus autilione [*sic*] Regan, 1923, Ann. Ent. Soc. Amer., 16: 179. [Present synonymy indicated.]

The strongly emarginate clypeus of the female of this species separates it at once from the other members of the subgenus, and suggests the species of *Lophopompilus,* from which it is separable by the virtual absence of erect hair on the pleura and propodeum. The median line of the male subgenital plate is elevated and bears a series of erect hairs; this is somewhat suggestive of the plumose tuft on the subgenital plate of *Lophopompilus,* and may represent a precursor of it. Indeed, this species is probably somewhat intermediate between these two subgenera, although the balance of characters clearly places it in *Arachnophroctonus.*

FEMALE.—Length 20 (17-23) mm. Color black; wings wholly fuliginous, rather strongly violaceous or bluish-refulgent. Puescence wholly dark, over most of the body reflecting deep bluish, violet, or blue-green, on the front, clypeus, and legs usually more or less brownish. Front and vertex with a small amount of short erect hair; pronotum very slightly hairy; metanotum with a few hairs on each side; propodeum with only some very fine, short, inconspicuous hairs; venter somewhat setose; pygidium densely bristly.

Head broader than high, the transfacial distance about 1.2 times the distance from the apical clypeal margin to the vertex crest. Clypeus convex, elevated, its apical margin with a large arcuate emargination; clypeus about 3 times as broad as high. Front broad, middle interocular distance about .57-.61 times the transfacial distance. Inner orbits subparallel below, convergent above, the upper interocular distance about .85-.90 times the lower interocular. Vertex raised considerably above the tops of the eyes; ocelli in a broad triangle, the front angle usually slightly greater than a right angle. First four antennal segments in a ratio of about 7:2:10:7, segment 3 equal to from .7 to .85 times the upper interocular distance.

Posterior margin of pronotum arcuate or with a vague median angulation. Propodeum with a well-defined oblique, flattened declivity; median line not or slightly impressed. Tarsal comb consisting of spines on the average about 1½ times as long as the thickness of the tarsus; basitarsus with 3 comb-spines (rarely a weak fourth), the apical one about half the length of the second tarsal segment. Fore wing with the second submarginal cell rather long, usually about twice as long as high, narrowed by not more than one-fourth above; third submarginal cell about 1½ times as long as high, strongly narrowed above, almost subtriangular.

MALE.—Length 16 (10-22) mm. Color black; wings fuliginous, reflecting violet or bluish. Pubescence of the lower front and clypeus often silvery; elsewhere the pubescence is dark, rather richly refulgent of deep metallic colors, chiefly violet and deep blue-green. Scape not hairy; clypeus, front, and vertex with fairly abundant short hairs; pronotum, metanotum, propodeum, and pleura a little more hairy than in the female, but the hairs rather fine and inconspicuous; abdominal sternites beyond the first each with a few erect hairs, those on the apical sternite in a line along the median ridge.

Clypeus slightly convex, about twice as broad as high, its apical margin slightly arcuately concave. Front broad, middle interocular distance about .62 times the transfacial distance. Eyes divergent to somewhat above the middle, then slightly convergent at the top, the upper interocular distance subequal to or slightly greater than the lower interocular distance. Ocelli forming an obtuse angle in front, the postocellar line subequal to or less than the ocello-ocular line. First four antennal segments in a ratio of about 7:2:8:8, segment 3 about 2.2-2.5 times as long as thick.

Pronotum arcuate or feebly subangulate behind. Propodeum sloping gradually in front, rather precipitous behind. Last segment of front tarsus very slightly asymmetrical, the inner margin inconspicuously produced a little before the apex. Venation as in the female, the second submarginal cell usually only about 1½ times as broad as high.

Abdomen very slightly flattened above; venter a little hairy, without dense brushes of hair. Sternite 6 with a deep V-shaped emargination. Subgenital plate of moderate breadth, the apex broadly rounded, the median line elevated and provided with a series of suberect hairs. Genitalia (Fig. 80) with the parameres as long as or a little longer than the aedoeagus, setose on the squamae, outer margin, apex, and over most of the ventral surface. Volsellae with a number of strong setae on the basis; digiti very characteristic, somewhat spindle-shaped but strongly curved, the disc wholly clothed with prominent, strongly sinuate setae.

Biology.—This species is often collected on flowers; it has been taken on water hemlock (*Cicuta*), milkweed (*Asclepias*), mesquite (*Prosopis*), beargrass (*Nolina*), salt cedar (*Tamarix*), pepper vine (*Ampelopsis*), and horse mint (*Monarda*).

Distribution.—Lower Austral Zone, Mexico to Arizona and Texas, eastward along the Gulf coast to Florida, and north along the Atlantic coast to Cape May, New Jersey.

Specimens seen: 83 (26 ♀♀, 57 ♂♂). New Jersey: Cape May Co., 1 ♂, Cape May, 13 July [ANSP]; North Carolina: Pitt Co., 1 ♂, Greenville, 6 July [USNM]; South Carolina: Horry Co., 1 ♀, 2 ♂♂, Myrtle Beach, 5 July [USNM]; Georgia: Charlton Co., 2 ♂♂, Okefenokee Swamp, May, June [CU, MCZ]; Florida: Hendry Co., 6 ♂♂, LaBelle, 8-10 May [CU, MCZ]; Alabama: Mobile Co., 2 ♀♀, 1 ♂, Del Champs, 19 July [MCZ]; Tuscaloosa Co., 1 ♀, 24 June [HEE]; Mississippi: Lafayette Co., 1 ♀, Oxford, 5 May [MCZ]; Texas: many records, from Bastrop, Brazos, Brewster, Dallas, El Paso, Hunt, Jeff Davis, Kleburg, Kenedy, LaSalle, Llano, Presidio, Titus, and Williamson Cos.; New Mexico: Otero Co., 1 ♀, 12 mi. SW of Alamogordo, 27 July [HEE]; Arizona: many records, from Cochise, Gila, Pima, and Santa Cruz Cos.; Mexico: Chihuahua, 1 ♀, 92 km. N. of Chihuahua, June [AMNH].

2. **Anoplius (Arachnophroctonus) relativus** (Fox)

(Pl. XXI, figs. 146, 152.)

Pompilus relativus Fox, 1893, Canad. Ent., 25: 114. [Type: ♀; Ocean Co., N. J.; A.N.S.P. no. 412.]—Dalla Torre, 1897, Cat. Hymen., VIII, p. 315.

Anoplius relativus Viereck, 1906, Trans. Amer. Ent. Soc., 32: 239, 241. [N. Mex., Colo.]—Smith, 1910, Ann. Rpt. N. J. State Mus. 1909, p. 674. —Evans, 1950, Trans. Amer. Ent. Soc., 75: 268, pl. X, figs. 1 and 2.

Psammochares (Allocyphonyx) hesione Banks, 1910, Psyche, 17: 250. [Type: ♂; Douglas Co., Kansas (Snow); M.C.Z. no. 13,694.] New synonymy.

Psammochares (*Psammochares*) *relativus* Rohwer, 1916, Conn. Geol. Nat. Hist. Survey Bull. 22, p. 633. [Branford, Conn.]—Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 986.—Johnson, 1930, List Insect Fauna Nantucket, p. 110.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 128, 129. [N. C.]—Brimley, 1938, Insects No. Carolina, p. 434.

Psammochares difficilis Banks, 1917, Bull. Mus. Comp. Zool., 61: 105. [Type: ♀; Falls Church, Va., 8 Sept. (N. Banks); M.C.Z. no. 10,019.] [*Nec* Tournier, 1889.] New synonymy.

Anoplius confraternus Banks, 1926, Canad. Ent., 58: 201. [Type: ♀; Ridgeway, Ont., 24 July 1910 (M. C. VanDuzee); M.C.Z. no. 15,802.] New synonymy.

Psammochares henshawi Banks, 1939, Canad. Ent., 71: 226. [Type: ♀; Ainsworth, Wash., 20 July 1882; M.C.Z. no. 23,480.] New synonymy.

Psammochares relativus Dreisbach, 1949, Ent. Amer., (n. s.) 29: 36, pl. II, fig. 7.

Anoplius (*Arachnophroctonus*) *relativus* Krombein, 1950, Jour. Elisha Mitchell Sci. Soc., 65: 264.

This is one of the most widely distributed of North American Pompilini, and over much of its range not uncommon. It is a highly variable species, frequently misdetermined in collections; Banks has redescribed the species under four different names. The males are easily separated from other members of the subgenus by the strong brushes of hair on the venter, a character also possessed by several species of *Anoplius* s. str., however. The females closely resemble the preceding species, but the clypeus is truncate or at most slightly concave apically, and the body is somewhat more hairy.

Female.—Length 16 (11-21) mm. Color black; wings fuliginous, a little darker along the outer margin, more or less violaceous. Pubescence wholly dark, obscurely to rather strongly reflecting various shades of deep bluish. Body with a variable amount of erect hair; front and vertex moderately hairy; front coxae setose, the other coxae and the femora slightly hairy or not; pronotum, mesopleura, metanotum, and other parts of the thorax somewhat hairy; propodeum with considerable rather fine erect hair; venter somewhat setose; pygidium densely bristly.

Head broader than high, the transfacial distance about 1.15 times the facial distance. Clypeus 2.6 to 3 times as broad as high, its apical margin truncate or slightly concave. Front of very variable breadth, the middle interocular distance varying from .55 to .64 times the transfacial distance—an unusually broad range. Eyes slightly convergent above, the upper interocular distance from .82 to .92 times the lower interocular. Vertex raised only very slightly if at all above the eye-tops; ocelli forming about a right angle in front, or slightly greater; postocellar and ocello-ocular lines usually nearly equal. First four antennal segments in a ratio of about 7:2:11:9, segment 3 varying from .65 to .95 times the upper interocular distance. (The head of this species was figured by the author in part I of this study. [Evans, 1950, pl. X, fig. 1].)

Posterior margin of the pronotum varying from arcuate to broadly angulate. Propodeum with a well-defined oblique declivity, its sides not or barely protuberant. Front basitarsus with three comb-spines, the spines from 1.2 to 2.2 times as long as the thickness of the tarsus. Fore wing with the marginal cell large, about or slightly more or less than its own length from the wing-tip, the radial vein angled at the third transverse cubital vein. Second submarginal cell from 1 to 2 times as broad as high, narrowed somewhat above; third submarginal cell much narrowed above, often subtriangular, sometimes triangular (Fig. 152).

Male.—Length 13 (8-18) mm. Color black; wings fuliginous, with a darker marginal band, generally somewhat violaceous. Pubescence of lower front, sides of clypeus, base of mandibles, and temples often silvery; pubescence over most of the body dark, obscurely to rather strongly reflecting deep metallic colors. Scape slightly hairy or not; front, vertex, and temples with rather copious short, dark hair; front coxae, pronotum, mesopleura, and propodeum with considerable hair; first abdominal tergite slightly hairy near the base; sternites 2 and 3 each with a few hairs, sternites 4 and 5 with dense brushes of hairs, sternite 6 with some very short hair, the subgenital plate not noticeably hairy (Fig. 146).

Clypeus about twice as broad as high, its apical margin truncate or very slightly concave. Middle interocular distance varying from .58 to .65 times the transfacial distance; upper interocular distance subequal to or slightly greater than the lower interocular. Ocelli rather small and far apart, forming an angle in front which is greater than a right angle; postocellar line equal to or greater than the ocello-ocular line. First four antennal segments in a ratio of about 3:1:3:3.

Posterior pronotal margin arcuate or feebly angulate. Propodeum sloping but very slightly to near the posterior end, where there is a short, almost vertical declivity; postero-lateral angles slightly prominent. Last segment of front tarsus distinctly asymmetrical, the inner margin produced, the segment widest about two-thirds the distance from the base. Wing venation about as in the female, the marginal cell usually a little shorter, the third submarginal sometimes triangular, rarely petiolate. (Propodeum and abdomen shown in Fig. 146.)

Abdomen distinctly flattened dorsally, especially basally. Venter with strong brushes of hair, as described above. Sternite 6 with a shallow, broad emargination. Subgenital plate simple, of moderate breadth, the apex broadly rounded (rather similar to that of *americanus*, shown in Fig. 121). Genitalia very characteristic; parameres linear, very slightly curved, setose along the outer margin and especially at the apex; basis volsellaris with several long hairs; digiti slender, curved, the disc somewhat spindle-shaped and bearing a number of long clubbed setae which are directed outward and bent at an angle a short distance from their apices; aedoeagus fairly broad, slightly exceeding the slender, slightly curved parapenials. (The genitalia of this species were illustrated by the author in Part I of this study, Fig. 2, and also by Dreisbach, 1949.)

Biology.—This species is especially characteristic of sandy, gravelly, or waste areas in open country or along watercourses. In the absence of any published information on the biology of this fairly common species, the following observations of the author are described in some detail.

At 2:30 P.M. on a cloudy day late in September, a female *A. relativus* was found excavating a hole in a sand bank along the Connecticut River at East Hartford, Conn. The wasp would remain in the burrow about a minute at a time, each time she reappeared raking back sand with her tarsal comb. After 10 minutes of this the wasp ran off down the bank and out of sight for several minutes. She was next seen walking backward up the bank dragging a large spider behind her. After some difficulties caused by the steepness and irregularity of the slope and size of the spider, she finally deposited the spider on the crest of a mole-hill about 14 inches from the burrow. The wasp then returned to her digging for about half an hour, during which time 3 trips were made back to inspect the spider and drive off intruders. One of these was the small socially parasitic spider wasp *Evagetes padrinus minusculus* (Banks), which was driven off with a vengeance by the *relativus*. A small fly and an ant were also sent on their way by the excited wasp.

Having finally completed the burrow, the *relativus* ran quickly to her spider, which she grasped by the base of the legs with her mandibles and carried backward to the nest. The grade was steep, and it took her two minutes to make 9 inches; the spider was then deposited while a quick visit was made to the burrow; returning, the spider was carried directly to the edge of the burrow. Now the wasp changed her grip on the spider, grasping it by the spinnerets, and backed directly into the hole; the legs of the spider flipped backward over the cephalothorax and were the last to disappear. After its disappearance 13 minutes elapsed, when the wasp reappeared head first, raking sand behind her. For 20 minutes the process of filling went on; then for another 20 minutes there was no sign of the wasp. Since it was now 5 P.M. and very cool, it seemed possible that she intended to spend the night in the partially filled burrow. The wasp and the spider were therefore dug out. The burrow proved to be 5 inches in length, perfectly straight, and with the usual terminal cell containing the spider in an inverted position; the egg of the wasp was not found, most likely having been dislodged in the digging. The spider proved to be a ♀ *Agelenopsis naevia* (Walck.) (Agelenidae) [det. B. J. Kaston].

A. relativus is also a frequent visitor to flowers, and has been taken on the following: *Daucus carota, Cicuta maculata, Conium maculatum, Solidago, Baccharis glutinosus, Petalostemon oligophyllum, Vicia, Melilotus alba, Polytaenia nuttallii, Sphaeralcea angustifolia, Asclepias, Tamarix, Polygonum, Eriogonum, Angelica, Cleome serrulata, Helianthus, Monarda,* and *Euphorbia marginata.* Dates of collection vary widely, and indicate one generation a year in the North, and several in the South.

Distribution.—This is a very wide-ranging species, though principally characteristic of the Lower and Upper Austral Zones, its range extending from the Mexican states of Jalisco and Morelos north to British Columbia, Manitoba, Ontario, and Massachusetts.

Specimens seen: 784 (406 ♀♀, 378 ♂♂). The following records appear to define the periphery of the range of this species: MASSACHUSETTS: Norfolk Co., 2 ♀♀, Wellesley, Aug. [MCZ]; VERMONT: Windsor Co., 1 ♀, Woodstock, 13 Aug. [USNM]; NEW YORK: Essex Co., 3 ♀♀, New Russia, Aug., Sept. [CU]; ONTARIO: 3 ♀♀, 1 ♂, Ottawa, 24 July [HEE]; MICHIGAN: Cheboygan Co., 2 ♀♀, 1 ♂, Douglas Lake, July, Aug. [MCZ, CU]; MANITOBA: 1 ♀, 1 ♂, Aweme, Aug. [CNC]; ALBERTA: 1 ♀, Medicine Hat, July [CNC]; BRITISH COLUMBIA: 2 ♀♀, 2 ♂♂, Okanagan, May, July [CNC]; BAJA CALIFORNIA: 1 ♂, San Domingo, 19 July [CAS]; JALISCO: 2 ♀♀, Guadalajara [ANSP]; MORELOS: 1 ♂, Cuernavaca, Oct. [USNM]; TEXAS: Cameron Co., 1 ♀, Port Isabel, Apr. [Mass.]; LOUISIANA: 3 ♀♀, New Orleans [USNM]; FLORIDA: Lee Co., 1 ♂, Punta Rassa, May [CU].

3. Anoplius (Arachnophroctonus) xerophilus Evans (Pl. XII, fig. 81.)

Anoplius xerophilus Evans, 1947, Ent. News, 58: 10-14. [Type: ♂; Steins, N. Mex., 14 July 1917 (J. C. Bradley), on *Acacia greggii*; C. U. no. 2398.]

This apparently uncommon species is confined to desert regions of the deep Southwest. It is clearly distinguishable from other members of this species-group by the very broad vertex, the steep propodeal declivity, and the characters of the male terminalia.

FEMALE.—Length 12.5 (12-13) mm. Color black; wings fuliginous, with a slightly darker marginal band, slightly violaceous. Pubescence dark, somewhat violaceous. Scape not hairy; front and vertex with considerable short, black hair; pronotum, scutellum, and mesonotum slightly hairy, the propodeum conspicuously so; abdominal sternites each with a few setae, the apical tergite rather densely bristly.

Head broadly oval, the transfacial distance about 1.2 times the facial distance. Clypeus about 2.6 times as broad as high, slightly broader than the lower front, its apical margin truncate. Front broad, the middle interocular distance .63 times the transfacial; eyes diverging above, the middle interocular distance from 1.2 to 1.3 times the lower interocular, the upper interocular distance about 1.1 times the lower. Ocelli in a broad, flat triangle, the front angle much greater than a right angle; postocellar line slightly less than the ocello-ocular. First four antennal segments in a ratio of about 3 : 1 : 3.8 : 3.3, segment 3 only very slightly more than half the upper interocular distance. Vertex scarcely raised above the tops of the eyes; head contracted immediately behind the eyes.

Pronotum rather long, its posterior margin feebly angulate. Propodeum with an abrupt, oblique, somewhat concave declivity behind, the sides of the declivity faintly protuberant. Front femur with a slight compression on the outside about one-third the way from the base, as though pinched at this point. Spines of the tarsal comb only slightly longer than the width of the tarsus; basitarsus with three comb-spines. Pulvillar comb of about 14 setulae. Fore wing with the marginal cell about its own length from the wing-tip; radial vein nearly evenly arcuate; second and third submarginal cells both four-sided, both somewhat narrowed above. First abdominal tergite somewhat swollen, the anterior surface nearly perpendicular to the dorsal; median line of this tergite slightly impressed.

MALE.—Length 10 (8-12) mm. Color black; wings lightly to rather heavily infuscated, with a darker band along the outer margin. Pubescence largely brownish-violaceous, often silvery on the lower front, clypeus, and base of the mandibles, occasionally also on parts of the pronotum and propodeum. Scape not or barely hairy; front, vertex, temples, and propleura with abundant short, dark hair; thoracic nota, pleura, and coxae barely to moderately hairy; propodeum always with considerable hair; first abdominal tergite often a little hairy near the base, but the rest of the abdomen practically devoid of erect hair.

Head very broad, the transfacial distance from 1.2-1.3 times the facial distance. Clypeus about as wide as the lower front, truncate below. Front very broad, the middle interocular distance from .63 to .67 times the transfacial distance, and about 1.3 times the lower interocular distance. Vertex very broad, the upper interocular distance about 1.2 times the lower interocular. Vertex slightly raised in the region of the ocelli, the ocelli about as in the female. First four antennal segments in a ratio of about 3 : 1 : 3 : 2.8, or segment 4 sometimes as long as 3; first 4 segments together a little greater than the upper interocular distance.

Posterior pronotal margin arcuate or feebly angulate. Propodeum sloping but little to near the posterior margin, where it is almost vertically declivous, the sides of the declivity faintly protuberant. Front femora pinched as in the female; middle and especially the hind femora strongly compressed throughout. Last segment of front tarsus distinctly lobed on the inner margin; inner claw of this tarsus strongly modified. Venation about as in the female; radial vein of fore wing sometimes slightly angled; third submarginal cell often narrowed above more than the second.

Abdominal dorsum flattened slightly, especially toward the base; venter not or scarcely hairy. Sternite 6 with a deep V-shaped emargination. Subgenital plate fairly broad, the sides approaching to a subacute apex; median line weakly carinate; outer sides of plate rather weakly pigmented; plate without erect hairs, only fine pubescence. Genitalia (Fig. 81) most like those of *bellicosus*; parameres straight, linear; volsellae with a few strong setae on the basis, the digitus a little curved, the disc somewhat spindle-shaped, clothed with abundant, moderately long setae which are bent at an angle near their apices; parapenials slender, slightly curved, embracing the aedoeagus, which is fairly broad, the apex weakly bilobed.

Biology.—The type and several paratypes of this species were collected on the pods of cats-claw, which were covered with a sweet exudate. I have collected males on the blossoms of milkweed. This species occurs in desert areas, and does not seem to be common.

Distribution.—This is a Lower Sonoran form, the known range extending from Lower California and western New Mexico to Utah (Millard Co.) and California (Fresno Co.).

Specimens seen: 14 (4 ♀♀, 10 ♂♂). NEW MEXICO: Hidalgo Co., 1 ♀, 4 ♂♂, Steins, 14 July (J. C. Bradley) [CU]; 1 ♀, 15 mi. W. of Lordsburg, Aug. (Werner & Nutting) [MCZ]; ARIZONA: Cochise Co., 1 ♂, Bowie, 14 July (J. C. Bradley) [CU]; 2 ♂♂, 2 mi. E. of Pearce, 9 Aug. (H. E. Evans) [HEE, USNM]; Pima Co., 1 ♂, Apache Camp, Santa Catalina Mts., 5500 feet, 25 July (J. Bequaert) [MCZ]; UTAH: Millard Co., 1 ♀, Beaver Pass, 4000 feet, 31 July (E. R. Tinkham) [Minn.]; CALIFORNIA: Fresno Co., 1 ♂, Coalinga, 1-3 June (J. C. Bradley) [CU]; Inyo Co., 1 ♀, Wild Rose Canyon, 24 Aug. [CIS]; BAJA CALIFORNIA: 1 ♂, 10 mi. S. of Punta Prieta, 21 June (Michelbacher & Ross) [CAS].

4. **Anoplius (Arachnophroctonus) marginalis** (Banks)
(Pl. XIII, fig. 84.)

Sphex tropica Fabricius, 1775, Syst. Ent., p. 350. [Type: ♀?; "America"; (location unknown to present author).] [*Nec* Linnaeus, 1758.]—Fabricius, 1793, Ent. Syst. Emend. & Aucta, II, p. 213.

Pompilus tropicus Fabricius, 1798, Suppl. Ent. Syst., p. 250.—Fabricius, 1804, Syst. Piezatorum, p. 194.—Jurine, 1807, Nouv. Meth. Class. Hymen. & Dipt., p. 121.—Dahlbom, 1844, Hymen. Europ., I, p. 62.—Lepeletier, 1845, Hist. Nat. Insect. Hymen., III, p. 434.—F. Smith, 1855, Cat. Hymen. Brit. Mus., III, p. 161.—Cresson, 1867, Trans. Amer. Ent. Soc., 1: 98. [Pa., Del., Ga., Ill.]—Cresson, 1872, Trans. Amer. Ent. Soc., 4: 203. [Texas.]—Dalla Torre, 1897, Cat. Hymen., VIII, p. 328.—Birkman, 1899, Ent. News, 10: 244. [Fedor, Lee Co., Tex.]

Arachnophroctonus tropicus Howard, 1901, The Insect Book, pl. VII, fig. 11.—Pate, 1946, Trans. Amer. Ent. Soc., 72: 129. [Designated genotype.]

Psammochares marginalis Banks, 1910 (June), Jour. N. Y. Ent. Soc. 18: 118. [Type: ♀; Southern Pines, No. Carolina, 23 May (A. H. Manee); M.C.Z. no. 13,685.]—Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 128, 129.

Psammochares castella Banks, 1910 (Dec.), Psyche, 17: 248. [Type: ♂; Fedor, Lee Co., Texas, 3 May 1909 (Birkmann); M.C.Z. no. 13,689.] New synonymy.—Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.

Anoplius tropicus J. Smith, 1910, Ann. Rpt. N. J. State Mus. 1909, p. 674.

Psammochares tropicus Banks, 1912, Ent. News, 23: 108. [At flowers of *Ceanothus* in Va.]—Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 986. [Long and Staten Islands, N. Y.]—Johnson, 1930, List Insect Fauna Nantucket, p. 110.

Pompiloides tropicus Rohwer, 1916, Conn. Geol. Nat. Hist. Survey Bull. 22, pp. 631, 632. [New Haven, Conn.]—Rau and Rau, 1918, Wasp Studies Afield, pp. 45-58. [Biology.]—Robertson, 1928, Trans. Acad. Sci. St. Louis, 25: 307. [Flower records.]

Psammochares fabricii Banks, 1933, Psyche, 40: 6. [Proposed as a new name for *tropicus* Fabricius, preoccupied.] New synonymy.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 128, 129. [N. C., many records.]—Brimley, 1938, Insects N. Carolina, p. 434.

Anoplius (*Arachnophroctonus*) *marginalis* Krombein, 1950, Jour. Elisha Mitchell Sci. Soc., 65: 264.

This well-known species has long been called *tropicus* or, in the more recent literature, *fabricii*. The correct name, however, is *marginalis*, as the type of this species indubitably falls within the range of variation of *tropicus-fabricii*, and is the earliest valid name for the species. The only member of this species-group marked with orange, *marginalis* is rather readily identified. The male subgenital plate is very characteristic: it is broad and nearly flat, the very broadly rounded apical margin fringed with hairs.

Female.—Length 15.5 (11-20) mm. Color black, the upper outer orbits often with a narrow streak of pale, the second abdominal tergite with a broad band of orange, emarginate behind medially; in a few specimens the orange extends to the adjacent tergites, occasionally even to the sternites. Wings wholly fuliginous, somewhat violaceous. Pubescence wholly somewhat brownish, obscurely reflecting deep metallic colors. Head and thorax with a variable amount of dark erect hair; propodeum with at least some fine, short hair, sometimes strongly hairy.

Clypeus very broad, from 2.6 to 3 times as broad as high, its apical margin broadly rounded or subtruncate. Front broad, the middle interocular distance from .57 to .65 times the transfacial distance. Inner orbits subparallel below, converging slightly above, the upper interocular distance from .85 to .95 times the lower interocular distance. Ocelli small and widely separated, in a triangle somewhat below the crest of the vertex, the front angle somewhat greater than a right angle; postocellar line less than the ocello-ocular. Antennae short for the genus, the first four segments in a ratio of about 7:2:10:8, segment 3 from .55 to .7 times the upper interocular distance. Head rather thick, the temples well developed.

Posterior margin of the pronotum broadly angulate, sometimes rather indistinctly so. Propodeum short, the median line impressed, posteriorly with a fairly well-defined flattened declivity. Front tarsus with a strong tarsal comb, the spines 1.5 to 2 times as long as the width of the tarsus; basitarsus with from 3 to 5 (most commonly 4) comb-spines. Fore wing with the marginal cell about 2.5 times as long as high, the radial vein angled at the third transverse cubital vein. Second submarginal cell rhomboidal, a little narrowed above, usually about 1.5 times as broad as high; third submarginal cell narrowed above by at least .8, typically nearly triangular, occasionally triangular.

Male.—Length 12 (6.5-17) mm. Color of body and wings as in the female, except that the orange somewhat more frequently extends beyond the limits of the 2d abdominal tergite. Pubescence in large part brownish-violaceous, in certain lights reflecting deep blue-green; occasionally the pubescence is silvery on the sides of the lower front and clypeus. Scape hairy below; front rather densely hairy; propodeum with considerable hair; disc of subgenital plate clothed with short hairs, the outer margin fringed with longer, curved hairs.

Clypeus a little over twice as broad as high, its apical margin truncate or slightly rounded. Front of very variable width, the middle interocular distance varying from .56 to .64 times the transfacial distance. Eyes diverging slightly above, the upper interocular distance from 1.0 to 1.15 times the lower interocular. Ocelli small, forming an obtuse angle in front; postocellar line: ocello-ocular line about as 9:10. Posterior pronotal margin angulate or subangulate. Propodeum sloping very gradually in front, more steeply behind, the declivity short but less abrupt than in the preceding two species; median line well impressed. Last segment of front tarsus produced on the inner margin; both claws of this tarsus somewhat modified, the inner strongly so. Venation as in the female, the marginal and second submarginal cells usually slightly shorter.

Abdominal dorsum slightly flattened; venter with only a few weak setae. Sternite 6 broadly and shallowly emarginate. Subgenital plate broad, very broadly rounded apically, the surface flat or very slightly raised medially; outer margins fringed with fairly long, curved setae. Genitalia (Fig. 84) with the parameres strong, slender and attenuate apically, clothed with strong setae on the outer margin and entire ventral surface; volsella with a group of weak setae on the basis, the digitus broadened and slightly curved apically, the tip subacute, the disc clothed (except near the tip) with short setae, most of which are bent at an angle near their tip; parapenials slender, curved; aedoeagus broadest subapically, the margins here a little ragged, the apex narrowed, weakly bilobed.

Gynandromorph.—There is a gynandromorph of this species in the collection of the University of Minnesota, taken by C. E. Mickel in a sand area at Jordan, Minn., 13 July 1923. The head of this specimen is thoroughly male, the abdomen thoroughly female, the left side of the thorax and propodeum male, the right, female.

Biology.—We are indebted to the Raus (1918) for a long and vivid account of the habits of this species. They found it nesting in bare spots in fields, and preying upon *Lycosa frondicola* Emerton, *Lycosa carolinensis* Walck. (Lycosidae), and *Pellenes coecatus* Hentz (Salticidae). The burrow (see Figs. 10 and 11 in Rau and Rau, pp. 53 and 56) is straight, either vertical or oblique, about 2 or 3 inches long, terminating in an oval chamber. They also watched this species stalking a web-spinning spider in its web without becoming entangled.

The Raus observed this species feeding upon the blood exuding from wounds made by the wasp on the spider, and they suggest that this may be the only food of the adult *marginalis*. However, the species is now known to visit a considerable number of flowers, as follows: *Daucus carota, Pastinaca sativa, Solidago, Ceanothus, Monarda, Potentilla, Euphorbia marginata,* and *Stillingia sylvatica.*

Distribution.—This species occurs principally within the limits of the Lower and Upper Austral Zones, from Arizona, Texas, and Florida to Utah, Manitoba, southern Ontario, and Massachusetts.

Specimens seen: 410 (269 ♀♀, 140 ♂♂, 1 gynandromorph). The following records are marginal: MASSACHUSETTS: Suffolk Co., 1 ♂, Chelsea, July [MCZ]; Hampshire Co., 4 ♀♀, 3 ♂♂, Amherst, June-Aug. [Mass.]; NEW YORK: Putnam Co., 1 ♂, Patterson, 26 July [KVK]; NEW JERSEY: Burlington Co., 1 ♂, Road to Speedwell, June [ANSP]; VIRGINIA: Fairfax Co., 2 ♀♀, 1 ♂, Falls Church, June-Aug. [MCZ]; NORTH CAROLINA: Buncombe Co., 1 ♀, Swannanoa, Sept. [HEE]; PENNSYLVANIA: Erie Co., 3 ♀♀, 3 ♂♂, Presque Isle, July-Aug., on beach [CM]; ONTARIO: 2 ♀♀, 2 ♂♂, Toronto, 6 July [CNC]; 1 ♀, 1 ♂, Pt. Pelee, July [CNC]; MICHIGAN: Midland Co., 1 ♀, 21 July [MCZ]; WISCONSIN: Wood Co., 1 ♀, Cranmoor, Aug. [USNM]; MANITOBA: 2 ♀♀, Aweme, July-Aug. [CNC]; SOUTH DAKOTA: Harding Co., 1 ♀, 3 ♂♂, Buffalo, July-Sept. [SDS]; NEBRASKA: Kimball Co., 1 ♂, 5000 feet, 6 Aug. [OSC]; COLORADO: El Paso Co., 3 ♀♀, Drennan Blowout, 17 Aug. [Minn.]; Moffat Co., 2 ♂♂, Sunbeam, 12 July [CU]; UTAH: Emery Co., 2 ♀♀, 2 ♂♂, 16 July-23 Aug. [Minn.]; ARIZONA: Navajo Co., 1 ♀, 2 ♂♂, Kayenta, 16 July [CAS]; Pima Co., 1 ♀, Marsh Pass, 28 June [CU]; NEW MEXICO: Luna Co., 1 ♂, 10 mi. E. of Deming, 12 July [CU]; TEXAS: Kenedy Co., 1 ♂, Armstrong, 12 July [HEE]; ALABAMA: 1 ♀, Mobile, Oct. [CAS]; FLORIDA: Pasco Co., 2 ♀♀, Lacoochee, 7 July [UK].

Apiculatus Species-group

The two species *apiculatus* Smith and *semirufus* Cresson possess numerous characters in common and represent a somewhat divergent element in the subgenus, for which the name *Arachnodaïcter* Pate is available for splitters. In these species the tarsal comb is very long, the spines from 1.5 to 3.5 times as long as the width of the tarsus, the one at the apex of the basitarsus from two-thirds to one and one-third times the length of the second tarsal segment. The wings are at most lightly infuscated basally, with a darker marginal band; the body is usually extensively clothed with silvery pubescence; the hairs on the temples and propleura are whitish; both sexes of each species are marked with orange on the basal abdominal segments; the median line of the propodeum is strongly impressed, and there is a deep median sulcus at the base of the first abdominal tergite; the male genitalia of the two species are very similar.

The first species, *apiculatus,* is divisible into three subspecies on characters present in the female sex only. Males can be determined only by inference. It is possible that there is no genetic basis for the factors which separate the females, but that the differences are due to the direct effect of the environment. I leave this problem for future investigators.

5a. Anoplius (Arachnophroctonus) apiculatus apiculatus (Smith)

(Pl. XII, fig. 82; pl. XVIII, fig. 119.)

Pompilus apiculatus Smith, 1855, Cat. Hymen. Brit. Mus., III, p. 157. [Type: ♀; Vera Cruz, Mexico; British Museum (not seen by present writer).]—Cresson, 1867, Trans. Amer. Ent. Soc., 1: 103.—Cameron, 1893, Biol. Centr.-Amer., Hymen., II, p. 205 and pl. XI, fig. 25.—Dalla Torre, 1897, Cat. Hymen., VIII, p. 273.

Anoplius (*Pompilinus*) *apiculatus* Viereck, 1906, Trans. Amer. Ent. Soc., 32: 223, 232. [Galveston, Tex., and Williams, Ariz.]

This distinctive species is not likely to be confused with any other. The nominate subspecies is predominantly Mexican, but is not uncommon in the southern parts of the four states of the United States which border Mexico.

FEMALE.—Length 10.5 (7.5-14) mm. Head and thorax black; abdomen bright rufo-ferruginous, except that the extreme base of the first segment is black, and the last segment (and sometimes part of the penultimate segment) is suffused with blackish. Wings hyaline or lightly infuscated, the outer margin of the fore wing with a prominent fuscous band, which extends into the upper, outer part of the marginal cell; apex of the hind wing somewhat infuscated. Body patterned with pale and dark pubescence; the pubescence is conspicuously silvery or somewhat glaucous on the following parts, elsewhere dark: base of mandibles; clypeus except sometimes for a median spot; temples; at least the lower front, often the whole front and vertex except for a narrow band connecting the tops of the eyes; pronotum at least anteriorly and in a prominent band along the posterior margin; posterior and postero-lateral margins of the mesonotum, either narrowly or broadly; sides of scutellum; metanotum except sometimes a median spot; propodeum except sometimes on the sides; part or all of the meso- and metapleura; coxae in large part, and to a variable extent the remainder of the legs; abdomen except sometimes toward the apex. Front and vertex with sparse but prominent dark hairs; temples and propleura with abundant pale hairs; front coxae and pronotum slightly hairy; propodeum with at most a very few fine, short hairs on the sides; first abdominal tergite with some light, pale hair anteriorly; sternites each with a few dark setae, more abundant caudad; apical tergite with a number of long setae anteriorly and several stout bristles posteriorly.

Mandibles very slender, with two rather weak teeth on the inner margin. Clypeus about three times as broad as high, its apical margin truncate. Front of moderate breadth, the middle interocular distance from .53 to .58 times the transfacial distance; front with a prominent impressed line from the antennal bases to the anterior ocellus. Inner orbits subparallel below, slightly converging above, the upper interocular distance from .8 to .9 times the lower interocular. Ocelli forming an acute angle in front; postocellar line: ocello-ocular line about as 7:6. Antennae a little short for the genus, the first four segments in a ratio of about 6:2:9:8, segment 3 varying from .62 to .85 times the upper interocular distance.

Posterior pronotal margin arcuate or feebly angulate. Postnotum one-third to two-thirds as long as the metanotum, with a prominent median impression from which extend on each side a number of transverse striations. Propodeum with the slope a little flat behind; median line distinctly impressed. Mesosternum produced over the inner bases of the middle coxae as small lobes, angulate apically, not slender and spiniform as in *semirufus*. Front tarsus with a strong comb, the spines rather flat, often pale at the tip, from 2.2 to 2.5 times as long as the width of the tarsal segments; basitarsus with 3 comb-spines, the apical one about as long as the second tarsal segment, or somewhat longer. Pulvillar comb of about 18 setulae. Cubitus of hind wing arising slightly beyond the tip of the submedian cell. Transverse median vein of fore wing interstitial with the basal on the media, or it may be a little before or beyond. Marginal cell about 2.5 times as long as high, the radial vein angled at the third transverse cubital vein. Second submarginal cell narrowed by less than half above; third submarginal cell triangular or nearly so, rarely short-petiolate, the third transverse cubital vein rather strongly arched. Base of the first abdominal tergite with a deep median sulcus. Apical tergite of the usual form, not unusually prominent, generally less bristly than is usual in the genus.

MALE.—Length 7 (5.8-8) mm. Color black; basal three segments of abdomen orange except for the base of the first and usually the apical margin of the third; occasionally part of the fourth segment is orange. Wings hyaline, the outer margin of the fore wing with a prominent brownish band which extends into the outer part of the marginal cell; apex of hind wing somewhat clouded. Almost the entire body is clothed with a coarse silvery or somewhat glaucous pubescence, absent from the following parts: antennae beyond the scape; a band across the vertex; a band across the pronotum just before the hind margin, interrupted medially; greater part of the mesonotum; disc of the scutellum; postnotum; underside of middle and hind tibiae; most of the tarsi; usually the basal parts of the 4th and 5th abdominal tergites, and the greater part of the sternites beyond the third. Front slightly hairy; temples and propleura with fine, pale hair; front coxae and pronotum very slightly hairy; remainder of head and thorax devoid of erect hairs; abdomen with only a few short, inconspicuous setae on the apical segments.

Clypeus 2.2 to 2.6 times as broad as high, its apical margin truncate. Front of moderate breadth, the middle interocular distance .58 to .64 times the transfacial distance. Inner orbits diverging above, the upper interocular distance about 1.15 times the lower. Ocelli rather far apart, forming an acute angle in front. First four antennal segments in a ratio of about 5:2:4.8:5, segment 3 from 2 to 2.3 times as long as thick. Pronotum arcuate or feebly angulate behind; postnotum as in the female. Propodeum rather convex, sloping more steeply behind, its median line strongly impressed anteriorly. Last segment of front tarsus weakly produced on the inner margin, the claw on this side strongly modified. Venation as in the female.

Abdomen slender, cylindrical. Sternite 5 with a large arcuate emargination posteriorly. Sternite 6 with a more narrow, U-shaped emargination. Subgenital plate (Fig. 119) with a broad basal sclerite, the plate itself broadly rounded or obtusely angled apically. Genitalia (Fig. 82) similar to those of *marginalis* and *semirufus*; parameres curved, the outer margins with numerous strong setae, but less densely setose than in *marginalis*; digiti clothed with numerous rather stout setae which are angled at their apices, except that the extreme apices of the digiti are bare.

Biology.—This species is characteristic of stream-banks where the soil is sandy or gravelly. It stays close to the ground and is a very active, excitable species; the males are very difficult to capture or even to see, because of their small size, erratic flight, and the pale pubescence which makes them blend very well with the sand. This species apparently does not visit flowers.

Distribution.—This is a Lower Sonoran subspecies, ranging from Central America to the southern parts of California, Arizona, and Texas.

Specimens seen: 98 (75 ♀♀, 23 ♂♂). TEXAS: Galveston Co., 2 ♀♀, July [USNM, RWS]; Jeff Davis Co., 19 ♀♀, 8 ♂♂, Limpia Canyon, Davis Mts., 14-25 July [HEE, CU, ANSP]; Montgomery Co., 1 ♂, Willis, Aug. [USNM]; Victoria Co., 1 ♀, 25 June [MCZ]; Wharton Co., 3 ♀♀, 24 June [CU, MCZ]; ARIZONA: 1 ♀ (no further data) [USNM]; Maricopa Co., 3 ♀♀, Phoenix, 3 Aug. [CU, MCZ]; 5 ♀♀, Tempe, 1 Aug. [CU, MCZ]; Pima Co., 1 ♂, Arivaca, 26 July [UK]; 1 ♀, Sabino Canyon, 5 Aug. [HEE]; 1 ♀, Tucson, 2 Aug. [HEE]; Gila Co., 1 ♀, Globe, 6 Aug. [KVK]; Yuma Co., 1 ♀, Dome, 21 July [CAS]; 1 ♀, Yuma 14 Apr. [CAS]; CALIFORNIA: San Bernardino Co., 1 ♀, Colton, 8 Oct. [CAS]; 3 ♀♀, Mojave R., Apple Valley, 29 June [CIS]. MEXICO: 1 ♀ (no further data) [USNM]; Baja California, 3 ♀♀ Angeles Bay, 26-27 June [CAS]; 1 ♂, La Paz, 3 Jan. [CAS]; Vera Cruz (type locality); GUATEMALA: 3 ♂♂, Concepcion [USNM]; 18 ♀♀, 6 ♂♂, El Rancho, Feb. [USNM]; 1 ♀, Lake Atitlan, Feb. [USNM]; 2 ♀♀, Guatemala City, Feb. [USNM]; 1 ♀, Santa Maria, Mch. [USNM]; HONDURAS: 4 ♀♀, 3 ♂♂, Puerto Castilla, 27 Mch. [MCZ]; 1 ♀, Tela, Mch. [USNM]; CANAL ZONE: 1 ♀, Alhajuelo, Mch. [USNM].

5b. **Anoplius (Arachnophroctonus) apiculatus autumnalis** (Banks) new combination

Pompiloides (Nanopompilus) autumnalis Banks, 1914, Jour. N. Y. Ent. Soc., 22: 301. [Type: ♀; Ridgeway, Ontario, 9 Aug. 1908 (M. C. Van Duzee); M.C.Z. no. 13,686.]

Psammochares (Psammochares) autumnalis Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 128, 129. [N. C., several localities.]—Brimley, 1938, Insects N. Carolina, p. 434.

This subspecies is very similar to the preceding, but only the basal three or four segments of the abdomen of the female are rufous; the sericeous band along the posterior margin of the pronotum is always prominent. This form occurs north and east of the range of typical *apiculatus,* and like it occurs chiefly on beaches and sand-banks along water.

FEMALE.—Length 10 (7.5-13) mm. Head and thorax black; all but the base of abdominal segment 1 rufo-ferruginous, all of segment 2, and at least the basal half of the 3d tergite also rufo-ferruginous; sometimes the entire first 4 segments are colored, only the apical two segments being black; most commonly the basal three segments are mostly rufous, the apical three black. Body patterned with silvery pubescence much as in typical *apiculatus*; sometimes the thoracic pleura, coxae, and legs are without much if any silvery pubescence, but the band along the posterior pronotal margin is always distinct and complete. Other features as in the nominate subspecies.

MALE.—Length 7.5 (6.5-8.5) mm. In all respects similar to *apiculatus apiculatus*, from which it can be told only by locality, or by association with the female.

Distribution.—This form is characteristic of the Austroriparian and Carolinian faunas, ranging from Texas and Florida north to southeastern North Carolina, western New York, southern Ontario, Minnesota, and Kansas.

Specimens seen: 58 (44 ♀♀, 14 ♂♂). The following records are marginal: NORTH CAROLINA: Brunswick Co., 1 ♀, Smith Island, Oct. [USNM];

PENNSYLVANIA: Erie Co., 3 ♀♀, 1 ♂, Presque Isle, 10-13 July [CM]; NEW YORK: Cayuga Co., 2 ♀♀, 1 ♂, No. Fairhaven, Sept. [CU]; ONTARIO: 1 ♀, Ridgeway, 9 Aug. [MCZ]; ILLINOIS: 1 ♀, Chicago, Sept. [MCZ]; MINNESOTA: Wabasha Co., 1 ♀, Lake City, 12 Sept. [Minn.]; IOWA: Woodbury Co., 1 ♀, Sioux City [USNM]; KANSAS: Riley Co., 6 ♀♀, 1 Oct.-19 Nov. [KSC]; Rooks Co., 1 ♀, 9 Aug. [UK]; TEXAS: Cooke Co., 1 ♀, 26 July [RWS]; ALABAMA: Baldwin Co., 1 ♀, Orange Beach, 13 Aug. [CU]; FLORIDA: DeSoto Co., 4 ♀♀, 5 ♂♂, Arcadia, 9-10 Apr. [CU, HEE].

5c. Anoplius (Arachnophroctonus) apiculatus pretiosus (Banks)

Psammochares pretiosa Banks, 1910, Jour. N. Y. Ent. Soc., 18: 119. [Type. ♂; " N. Y." (Banks states in the description that this specimen is from Sea Cliff, L. I., N. Y.); M.C.Z. no. 13,695.]—Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 986.—Procter, 1938, Biol. Survey Mt. Desert Reg., VI, Insecta, p. 430.

Pompiloides (Nanopompilus) pretiosa Banks, 1914, Jour. N. Y. Ent. Soc., 22: 301.

Pompiloides (Nanopompilus) autumnalis var. *atlanticus* Banks, 1914, Jour. N. Y. Ent. Soc., 22: 301. [Type: ♀; Long Beach, L. I., N. Y., Aug.; M.C.Z. no. 13,684.] New synonymy.

Psammochares (Arachnophila) pretiosa Banks, 1917, Bull. Mus. Comp. Zool., 61: 107.

Psammochares (Psammochares) atlanticus Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 986.

Psammochares (Pompiloides) pretiosa Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 124, 126.—Brimley, 1938, Insects N. Carolina, p. 433.

Anoplius (Arachnophroctonus) pretiosus Krombein, 1950, Jour. Elisha Mitchell Sci. Soc., 65: 264. [Dare Co., N. C.]

This subspecies is colored like *autumnalis*, but the silvery pubescence is much reduced, giving the insect a much darker appearance; the mesopleura are scarcely if at all silvery, and the posterior margin of the pronotum is without the sericeous band characteristic of both the other subspecies, although it may be partially developed. These remarks pertain only to the female, the male being virtually indistinguishable from the other subspecies except by range.

FEMALE.—Length 10.5 (7-14) mm. Color black, the greater part of the first three abdominal segments rufo-ferruginous above and below; sometimes the base of the fourth tergite is also rufous. Pubescence mostly dark, somewhat brownish, sometimes silvery on the clypeus, front, anterior slope of the pronotum, sides of the scutellum and metanotum, propodeum, and the tibiae; the pubescence of the basal three abdominal segments is very fine, silvery. Body with erect hairs as in typical *apiculatus*; the numerous dark hairs on the front, and the finer, pale hairs on the temples and propleura are conspicuous. The spines of the tarsal comb tend to be slightly more slender and acute than in the typical subspecies, and they are often wholly black.

MALE.—Length 7.3 (6.5-8) mm. Very similar to *apiculatus apiculatus*; pubescence sometimes slightly less extensively silvery than described under that form.

Distribution.—This race occurs along the Atlantic coastal plain from Florida to Maine. From southern North Carolina southward the range overlaps that of the preceding subspecies.

Specimens seen: 111 (83 ♀♀, 28 ♂♂). MAINE: Hancock Co., 1 ♂ [MCZ]; Penobscot Co., 1 ♀, Bangor [MCZ]; 1 ♀, Orono [MCZ]; MASSACHUSETTS: Middlesex Co., 1 ♀, Malden [Mass.]; Norfolk Co., 1 ♂, Wellesley, 28 Aug. [MCZ]; Plymouth Co., 1 ♀, June [MCZ]; 1 ♀, Manomet, July [MCZ]; RHODE ISLAND: Block Island, 1 ♂, 28 Aug. [MCZ]; CONNECTICUT: Hartford Co., 15 ♀♀, 1 ♂, 20 June-6 Sept. [HEE, ANSP]; NEW YORK: Nassau Co., 20 ♀♀, Long Beach [MCZ, USNM, AMNH]; 1 ♂, Sea Cliff [MCZ]; Queens Co., 1 ♀, Belmont Park, 22 July [CU]; 1 ♀, Brooklyn, 9 Sept. [CU]; NEW JERSEY: 7 ♀♀, 1 ♂, Cape May, Monmouth, and Ocean Cos. [ANSP, USNM, CNC, MCZ]; VIRGINIA: Princess Anne Co., 1 ♀, 1 ♂, Cape Henry, 9 Sept. [USNM]; NORTH CAROLINA: Dare Co., 11 ♀♀, 16 ♂♂, Kill Devil Hills, 26 May-4 June [KVK]; GEORGIA: Decatur Co., 1 ♀, Spring Creek, 18-21 May [CU]; FLORIDA: 21 ♀♀, 5 ♂♂, Dade, DeSoto, Palm Beach, Sarasota and Volusia Cos. [AMNH, CU, HEE, KVK, USNM, MCZ].

6. **Anoplius (Arachnophroctonus) semirufus** (Cresson)

(Pl. XII, fig. 83; pl. XVIII, fig. 120.)

Pompilus semirufus Cresson, 1867, Trans. Amer. Ent. Soc., 1: 100. [Type: ♀; Georgia (no further data); A.N.S.P. no. 423.]—Dalla Torre, 1897, Cat. Hymen., VIII, p. 321.

Pompilus divisus Cresson, 1867, Trans. Amer. Ent. Soc., 1: 100. [Type: ♀; Georgia (no further data); A.N.S.P. no. 424.] New synonymy. —Dalla Torre, 1897, Cat. Hymen., VIII, p. 286.

Arachnophila divisa Ashmead, 1902, Canad. Ent., 34: 86. [Selected genotype of n. gen. *Arachnophila.*]

Anoplius divisus Smith, 1910, Ann. Rpt. N. J. State Mus. 1909, p. 674.

Psammochares (*Arachnophila*) *divisa* Banks, 1917, Bull. Mus. Comp. Zool., 61: 107.

Psammochares (*Pompiloides*) *semirufus* Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 987.

Arachnodaïcter divisus Pate, 1946, Trans. Amer. Ent. Soc., *72*: 74.

Anoplius (*Arachnophroctonus*) *semirufus* Krombein, 1950, Jour. Elisha Mitchell Sci. Soc., 65: 264. [Dare Co., N. C.]

The two species *semirufus* and *divisus* were described on the same page by Cresson, in that order. While the types seem rather different, it is apparent from the examination of further material that they both fall within the range of variation of a single species. Some females of this species are rather strikingly clothed with long, dark setae over much of the body, including even the propodeum, the abdominal dorsum, and the legs. In other specimens this is entirely lacking, and all possible intermediates seem to occur between the two extremes.

FEMALE.—Length 9.5 (7-13) mm. Color black, the base of the abdomen more or less orange in color, this coloration varying from pale to a rich rufo-ferruginous, covering at least the greater part of the first two tergites, and at most all of the first three segments, above and below, and the base of the fourth tergite. Integument of the head and thorax somewhat shining, that of the abdomen rather distinctly so. Wings lightly infuscated, darker along the outer margins. Pubescence silvery over the greater part of the body. Front and vertex with sparse dark hairs; temples and propleura with fine, pale hairs; scape slightly hairy or not. The amount of dark erect hair on the thorax and abdomen is very variable: in the minimum condition there is only a little on the front coxae and pronotum, none elsewhere except for the pygidium; in the maximum condition the entire thorax, including the legs even to the tarsi, the propodeum, and the entire abdomen, even dorsally, are beset with long, dark setae. Pygidium with a few bristles near its posterior margin, anteriorly with several to many long hairs; hypopygium with a number of setae.

Mandibles long, with two small teeth well back from the apex on the inner margin. Clypeus about three times as broad as high, the apical margin truncate. Front broad, the middle interocular distance from .60 to .65 times the transfacial distance. Inner orbits subparallel below, convergent above, the upper interocular distance from .7 to .82 times the lower. Ocelli forming about a right angle in front; postocellar and ocello-ocular lines usually nearly equal. Antennae slender, the first four segments in a ratio of about 15:5:21:17, segment 3 equal to from .70 to .85 times the upper interocular distance.

Posterior margin of pronotum subarcuate or subangulate. Propodeum sloping rather evenly, the median line well impressed. Mesosternum produced over the inner bases of the middle coxae in the form of a pair of small spiniform processes. Front tarsus with a strong comb, the spines slender, from 1.5 to 3 times as long as the width of the tarsus; basitarsus with 3 comb-spines. Fore wing with the marginal cell about 1.3 times its own length from the wing-tip; 2d submarginal cell 4-sided, narrowed slightly above by the slightly arched first transverse cubital vein; third submarginal cell triangular or nearly so, sometimes short-petiolate, the third transverse cubital vein rather strongly arched. Base of the first abdominal tergite with a deep median sulcus. Apical tergite somewhat swollen and prominent, the apical sternite also slightly so.

MALE.—Length 7.5 (6-9) mm. Color black, posterior pronotal margin sometimes obscurely marked with pale, second abdominal segment and adjacent parts of the first and third always marked with orange. Wings subhyaline, the outer margins with a darker band. Practically the entire insect clothed with a coarse silvery pubescence; pubescence of the flagellum, vertex, mesonotum, and last four abdominal segments more or less brownish, but the apical margins of the last four tergites usually silvery. Front and vertex with a few dark hairs; temples and propleura with whitish hairs; remainder of the body at most very obscurely hairy.

Clypeus about 2.5 times as broad as high, its apical margin truncate. Middle interocular distance from .61 to .66 times the transfacial distance, and about 1.15 times the lower interocular distance; upper interocular distance from .9 to 1.0 times the lower interocular. Ocelli forming an acute angle in front; postocellar line: ocello-ocular line about as 5:7. Antennae slender, the first four segments in a ratio of about 3:1:3:3, segment 3 from 2.5 to 3 times as long as thick. Posterior pronotal margin subarcuate or broadly angulate. Median line of propodeum impressed. Last segment of front tarsus rather strongly produced on the inner margin. Venation as in the female; third submarginal cell varying from petiolate to rather wide above.

Abdominal sternite 5 arcuately concave behind, less strongly so than in *apiculatus*. Sternite 6 with a more narrow, U-shaped emargination. Subgenital plate (Fig. 120) with the basal sclerite rather slender, the disc of the plate slightly elevated medially, bearing short, suberect setae, the apex tapering to a subacute or very narrowly rounded tip. Genitalia (Fig. 83) nearly identical to those of *apiculatus*, but the parameres of slightly greater relative length.

Biology.—This species, like the preceding, is confined rather strictly to sandy places. It does not frequently come to flowers, but has been taken on *Daucus carota* and *Chaerophyllum teinturieri*. Dates of capture vary widely, and suggest two or more generations a year through most of the range.

Distribution.—This species occurs throughout North America east of the Rockies, from the Lower Austral to the Transition

Zones, ranging from Texas and Florida to New Brunswick, Ontario, Manitoba, and Montana.

Specimens seen: 111 (76 ♀♀, 35 ♂♂). The following records are marginal: NEW BRUNSWICK: 1 ♂, Nerepis, 22 July [USNM]; QUEBEC: 1 ♂, Kazabazua, 4 Aug. [CNC]; ONTARIO: 1 ♂, Kearney, 6 July [MCZ]; MICHIGAN: Baraga Co., 1 ♀, Point Abbaye, 24 July [ANSP]; MANITOBA: 1 ♀, Aweme, 27 June [CNC]; MONTANA: 6 ♀♀, 2 ♂♂ (no further data) [ANSP]; Dawson Co., 1 ♀, Glendive, 17 June [USNM]; SOUTH DAKOTA: Bon Homme Co., 1 ♀, Springfield, 1 Sept. [SDS]; KANSAS: Logan Co., 1 ♀ [UK]; TEXAS: Hidalgo Co., 2 ♀♀, Feb., June [JEG, HEE]; LOUISIANA: 1 ♂ (no further data) [USNM]; ALABAMA: Clarke Co., 1 ♀, Thomasville, 11 June [MCZ]; FLORIDA: Orange Co., 1 ♀, Winter Garden, 12 March [Mass.].

Americanus Species-group

This group of two species bears strong resemblance to the following subgenus, *Pompilinus*. The tarsal comb of the female is reduced, the spines not being longer than the thickness of the tarsus; the propodeum is without erect hairs; the third submarginal cell is triangular, often petiolate. The pubescence is finer and less extensively silvery than in the preceding species-group. The front of the female is narrow, the middle interocular distance not more than .56 times the transfacial distance; the third antennal segment of the female is at least .9 the upper interocular distance. The male venter is at least a little hairy, and shows some tendency to form brushes of hair; in the genitalia the digiti are somewhat spindle-shaped and provided with numerous rather long hairs.

7a. **Anoplius (Arachnophroctonus) americanus americanus** (Beauvois)
(Pl. XIII, fig. 85; pl. XVIII, fig. 121.)

Pompilus americanus Palisot de Beauvois, 1805, Insectes Recueillis en Afrique et en Amérique, p. 117 and pl. III (Hymen.), fig. 6. [Type: ♀; United States (no further data); (location of type not known to present author).]—F. Smith, 1855, Cat. Hymen. Brit. Mus., III, p. 157. —Cresson, 1867, Trans. Amer. Ent. Soc., 1: 99. [Pa., Del., Md., Ill.] Cresson, 1872, Trans. Amer. Ent. Soc., 4: 203. [Texas.]—Dalla Torre, 1897, Cat. Hymen., VIII, p. 272.—Birkmann, 1899, Ent. News, 10: 244. [Lee Co., Tex.]

Pompilus plebejus Dahlbom, 1844, Hymen. Europ., I, p. 60. [Type: ♀; No. America (no further data); Univ. of Lund, Sweden (not seen by present author).]—F. Smith, 1855, Cat. Hymen. Brit. Mus., III, p. 157. [Present synonymy indicated.]

Entypus americanus Howard, 1901, The Insect Book, pl. VII, fig. 15.

Anoplius americanus J. Smith, 1910, Ann. Rpt. N. J. State Mus. 1909, p. 674.

Psammochares albomarginatus Banks, 1910, Jour. N. Y. Ent. Soc., 18: 114. [Type: ♂; Falls Church, Va., 1 July (Banks); M.C.Z. no. 13,678.] New synonymy.

Pompiloides americanus Rohwer, 1916, Conn. Geol. Nat. Hist. Survey Bull. 22, p. 631.—Rau, 1922, Trans. Acad. Sci. St. Louis, 24: 10-11. [Biology.]—Rau, 1926, Trans. Acad. Sci. St. Louis, 25: 210. [Biology.] —[?]Britton, 1938, Conn. Geol. Nat. Hist. Survey Bull. 60, p. 146.—[not] Procter, 1938, Biol. Survey Mt. Desert Reg., VI, Insecta, p. 430.

Psammochares (*Pompiloides*) *albomarginatus* Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 124, 125.—Brimley, 1938, Insects N. Carolina, p. 433.

Psammochares (*Pompiloides*) *americanus* Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—[?]Johnson, 1930, List Insect Fauna Nantucket, p. 111. —Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 124, 125.—Brimley, 1938, Insects N. Carolina, p. 433.

Pompiloides agnema Brimley, 1928, Jour. Elisha Mitchell Sci. Soc., 43: 204. [Type: ♂; Raleigh, N. C., 23 July 1924 (C. S. Brimley); Coll. N. C. Dept. Agri., Raleigh.] New synonymy.

Psammochares (*Pompiloides*) *agnema* Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 124, 125.—Brimley, 1938, Insects N. Carolina, p. 433.

Anoplius (*Arachnophroctonus*) *americanus* Krombein, 1950, Jour. Elisha Mitchell Sci. Soc., 65: 264.

The female of this well-known form may be recognized by the orange bands or paired spots on the second and third abdominal tergites; an occasional specimen is more extensively colored than this. There is almost always a certain amount of silvery pubescence on the lower front and clypeus. The male may be marked with orange or not; there is a pale stripe along the posterior pronotal margin (sometimes obsolescent); the third submarginal cell is normally petiolate, and the subgenital plate is rounded apically. The genitalia of this species are very distinctive (Fig. 85).

FEMALE.—Length 12 (9-16) mm. Color black, the second abdominal tergite with a pair of orange spots occupying most of the tergite, separated by a thin line or confluent medially, the third tergite with a similar pair of spots, but the spots smaller and confined to the anterior half or three-quarters of the segment. This is the typical coloration, but a few specimens have considerably more orange on the abdomen, much as in subspecies *juxtus*.

Wings subhyaline or lightly infuscated, with a darker outer marginal band. Pubescence very fine, somewhat brownish, on the lower front and clypeus generally silvery, sometimes also silvery on the temples, coxae, and parts of the thorax. Front and vertex with sparse hairs, as well as the pronotum and front coxae; greater part of the thorax, and the propodeum, with at most a very little inconspicuous hair; pygidium densely bristly.

Clypeus from 2.2 to 2.6 times as broad as high, its apical margin truncate. Front narrow, not much wider than the two eyes taken together, the middle interocular distance from .52 to .56 times the transfacial distance. Eyes convergent above; upper interocular distance from .75 to .86 times the lower. Ocelli forming an angle in front which is slightly less than a right angle; postocellar line: ocello-ocular line about as 5:4. First four antennal segments in a ratio of about 3:1:5:4, segment 3 nearly equal to the upper interocular distance (.9 to 1.1 times it). Vertex narrow, not at all elevated above the eye-tops.

Posterior margin of pronotum distinctly angulate. Propodeum short, rather convex, the declivity nearly flat, the median line lightly impressed in front. Front tarsus with a comb of spines which are not much if any longer than the width of the tarsus; basitarsus with 3 comb-spines, the apical one not over one-third the length of the second tarsal segment. Fore wing with the marginal cell about 1.3 times its own length from the wing-tip; third submarginal cell triangular or nearly so, not infrequently petiolate. First abdominal tergite with a median linear impression, but without the deep basal sulcus characteristic of the preceding two species; pygidium of normal shape.

MALE.—Length 9 (8-10.5) mm. Color black, posterior margin of pronotum with a pale yellowish line, interrupted medially (sometimes obsolescent), second abdominal tergite with or without a pair of orange spots, the orange occasionally extending to the sternites and adjacent tergites. Wings hyaline, the outer margins with a distinct fuscous band. Pubescence very fine, over much of the head and thorax distinctly silvery; basal abdominal tergites with some silvery sheen basally, the apical one or more tergites conspicuously silvery. Front and vertex with some very fine hair, the thorax and propodeum not or very obscurely hairy; abdominal sternites 2 through 5 each with a few dark erect hairs, 4 and 5 with somewhat more than the others.

Clypeus about twice as broad as high, truncate below. Front narrow or of moderate breadth; middle interocular distance varying from .54 to .62 times the transfacial distance. Upper interocular distance subequal to or slightly greater than the lower. Ocelli forming a right or acute angle in front, postocellar line and ocello-ocular line usually about equal. First four antennal segments in a ratio of about 17:5:15:16, segment 3 about 2.2 times as long as its greatest thickness. Posterior pronotal margin angulate. Slope of propodeum low, steeper behind; median line impressed. Last segment of front tarsus slightly produced on the inner margin. Venation as in the female, the marginal cell sometimes as much as twice its length from the wing-tip, the third submarginal cell very often petiolate.

Abdomen slender, subcylindrical. Sternite 5 slightly emarginate posteriorly; sternite 6 with a slit-like emargination posteriorly. Subgenital plate (Fig. 121) fairly broad, its apex rather broadly rounded, the disc slightly arcuately elevated medially. Genitalia (Fig. 85) with the parameres very slightly curved, linear. Digitus volsellaris of remarkable form: the disc is elongate-fusiform, acutely pointed apically; it is fringed all around with long setae which are angled at their apices; on the outer third of the outer side, these hairs are still longer, and some of them are weakly clubbed. Aedoeagus rather broad; parapenials slender, curved near their base.

Biology.—This species is partial to sandy or barren areas or clay banks, but is not confined to these. Rau (1922) reports two cases in which he took *americanus* with the spider *Pardosa nigropalpis* Emerton (= *milvina* Hentz) (Lycosidae), once in wheat stubble, and once in a sand bank. In the latter case the wasp was seen to deposit her spider under bits of loose clay several times during the search for a nesting site. He also reports this wasp with *Philodromus* sp. (Thomisidae), and in a later paper (1926) remarks that he found a female *americanus* in a spider web, " victim to the prey which she was pursuing ".

A. americanus juxtus is a common wasp along the Kansas River at Manhattan, Kansas, where I have taken three females with their prey, in every case the spider *Arctosa littoralis* (Hentz) [det. B. J. Kaston], a common lycosid occurring in the same habitat. The favorite nesting site seems to be sloping banks where the soil is intermediate in character between sand and clay. The prey is carried backward by the wasp, and when deposited during the search for a nesting-place, is sometimes (but not always) placed beneath a stick, leaf, or bit of earth, as first noted by Rau. The nest is an oblique burrow about four inches deep, and in the cases observed took the wasp between 80 and 100 minutes from the time the nest was started until the spider was dragged in. This wasp has been observed by the writer to be parasitized by the pompiline *Evagetes hyacinthinus* (Cresson) (see notes under that species in Part I of this study).

A. americanus americanus has been taken on the following flowers: *Daucus carota, Pastinaca sativa, Conium maculatum, Polygonum* spp., *Melilotus alba, Bifora americana, Tamarix gal-*

lica, Ampelopsis arborea, Polytaenia nuttallii, and *Solidago* sp. Flight records extend from May to October.

Distribution.—Carolinian and upper portion of the Austroriparian faunas, from central eastern Texas, Mississippi, and northern Georgia to South Dakota, Michigan, southern Ontario, Pennsylvania, and southeastern New York. There is a considerable band of overlap with the range of subspecies *juxtus,* but throughout much of this area, *americanus americanus* appears to be more characteristic of uplands and tributary stream-valleys, while *americanus juxtus* is more often found along the banks of the major watercourses. Thus the overlapping of the ranges may be more apparent than real.

Specimens seen: 232 (148 ♀♀, 84 ♂♂). The following records more or less define the outer limits of the range of this subspecies: NEW YORK: New York City, 1 ♀, Van Cortland Park, 3 Oct. [Mass.]; PENNSYLVANIA: Bucks Co., 1 ♀, Newtown, 25 July [MSV]; Cumberland Co., 2 ♀♀, 1 ♂, Carlisle, Aug. [USNM]; Allegheny Co., 6 ♀♀, July [CM]; ONTARIO: 1 ♀, Chatham, 21 Aug. [CNC]; MICHIGAN: Monroe Co., 1 ♀, LaSalle, 14 Aug. [USNM]; MINNESOTA: Ottertail Co., 1 ♀, Parkdale, Aug. [Minn.]; SOUTH DAKOTA: Bon Homme Co., 1 ♀, 1 ♂, Springfield, June, Sept. [SDS, MCZ]; NEBRASKA: Cuming Co., 1 ♀, West Point [USNM]; KANSAS: Seward Co., 1 ♀ [UK]; TEXAS: Dallas Co., 2 ♀♀ [MCZ]; Comal Co., 2 ♀♀, New Braunfels, 29 June [HEE]; Ft. Bend Co., 4 ♀♀, Richmond [MCZ]; LOUISIANA: Madison Co., 1 ♂, Mound, 12 May [USNM]; MISSISSIPPI: Adams Co., 1 ♀, Natchez, 16 May [USNM]; ALABAMA: Tuscaloosa Co., 1 ♀, 23 May [HEE]; GEORGIA: Fulton Co., 1 ♀, 2 ♂♂, Atlanta, June-July [EU, MCZ]; NORTH CAROLINA: Brunswick Co., 1 ♂, Southport, 10 Oct. [USNM].

7b. **Anoplius (Arachnophroctonus) americanus trifasciatus** (Beauvois) new combination

Pompilus trifasciatus Palisot de Beauvois, 1805, Insectes Recueillis en Afrique et en Amérique, p. 118 and pl. III (Hymen.), fig. 7. [Type: ♀; United States (no further data); (location of type unknown to present author).]—Smith, 1855, Cat. Hymen. Brit. Mus., III, p. 157. [Placed in synonymy with *americanus.*]—Dalla Torre, 1897, Cat. Hymen., VIII, p. 272. [Listed as synonym of *americanus.*]

Pompilus americanus var. *trifasciatus* Cresson, 1867, Trans. Amer. Ent. Soc., 1: 99.—Cresson, 1887, Synopsis Hymen., Suppl. Vol. Trans. Amer. Ent. Soc., p. 271.

Psammochares eurydice Banks, 1921, Ann. Ent. Soc. Amer., 14: 49. [Type: ♀; Spring Creek, Decatur Co., Ga., 16-29 July 1912 (J. C. Bradley);

M.C.Z. no. 13,687.] New synonymy.—[?]Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 128, 129.—[?]Brimley, 1938, Insects N. Carolina, p. 433.

This form averages somewhat larger than typical *americanus* and is somewhat darker in appearance; the orange markings, which usually extend on to the first tergite in this form, are of a darker shade, the pubescence is never at all silvery, and the wings are generally a little more heavily infuscated. These remarks pertain only to the females, as the males are not clearly distinguishable from those of the nominate subspecies.

FEMALE.—Length 13.5 (10-20) mm. Color black, the abdomen marked with orange-brown as follows: posterior two-thirds or less of the first tergite (occasionally this tergite is all black), greater part of the second tergite, and the third tergite with a pair of basal spots which may be confluent into a band which is emarginate posteriorly; rarely the coloration extends to some extent to the sternites. Wings lightly to rather heavily infuscated, with a darker marginal band, sometimes somewhat violaceous. Pubescence dark, more or less brownish-cinereous, nowhere silvery. Other features as described under the nominate subspecies.

MALE.—Length 9.5 (8.5-11) mm. Color black, the posterior margin of the pronotum with a pale line, the abdomen marked with a variable amount of orange or orange-brown: most commonly the second segment is ringed with orange, the color sometimes extending to the adjacent segments; in a few specimens the orange color is reduced or absent. Wings hyaline or lightly infuscated, the outer margins with a fuscous band. Pubescence of body generally extensively silvery, as in the typical subspecies. In all other features essentially the same as *americanus americanus*, from which this form cannot truly be distinguished in this sex except by range.

Distribution.—This subspecies occurs not uncommonly throughout Florida and Georgia, except in the northern part of the latter state. Quite likely it occurs in the coastal portions of the Carolinas, although I have not seen specimens from these states.

Specimens seen: 50 (36 ♀♀, 14 ♂♂). GEORGIA: Appling, Bryan, Charlton, Decatur, Glynn, Lanier, Macon, Mitchell, Stephens, Thomas, and Tift Cos., numerous specimens [USNM, CU, EU, ANSP, UK, MCZ]; FLORIDA: Brevard, Dade, Duval, Highlands, Orange, Polk, Seminole, and Volusia Cos., numerous specimens [AMNH, CU, CNC, USNM, JEG, MCZ, KVK, Mass.]

7c. **Anoplius (Arachnophroctonus) americanus juxtus** (Cresson) new combination

Pompilus juxtus Cresson, 1865, Proc. Ent. Soc. Phila., 4: 128. [Type: ♀; Cuba (no further data); A.N.S.P. no. 421.]

Pompilus subargenteus Cresson, 1865, Proc. Ent. Soc. Phila., 4: 129. [Type: ♂; Cuba (no further data); Coll. J. Gundlach, Instituto de Segunda Enseñanza, Havana (not seen by present writer).] New synonymy. —Cresson, 1867, Trans. Amer. Ent. Soc., 1: 103.—Cameron, 1893, Biol. Centr.-Amer., Hymen. II, p. 205.—Dalla Torre, 1897, Cat. Hymen., VIII, p. 325.

Pompilus coruscus var. *juxtus* Cresson, 1867, Trans. Amer. Ent. Soc., 1: 103.[8]—Cresson, 1869, Proc. Boston Soc. Nat. Hist., 12: 370. [Orizaba, Mex.]—Fox, 1894, Proc. Calif. Acad. Sci., (2)4: 99.. [San José del Cabo, Baja Calif., Mex.]—Dalla Torre, 1897, Cat. Hymen., VIII, p. 283.

Psammochares (Pompiloides) semirufus Banks, 1917, Bull. Mus. Comp. Zoöl., 61: 108. [*Nec* Cresson, 1867; misidentification.]

Pompiloides juxta Banks, 1928, Harv. Biol. Lab. Cuba (Atkins Found.), Studies on Cuban Insects, I, p. 9. [Cuba.]

Pompiloides subargenteus Banks, 1928, Harv. Biol. Lab. Cuba (Atkins Found.), Studies on Cuban Insects, I, p. 9. [Bahamas.]—Banks, 1931, Bull. Brooklyn Ent. Soc., 26: 133. [Yucatan.]

Anoplius puella Banks, 1941, Canad. Ent., 73: 121. [Type: ♂; Galveston, Tex., June; M.C.Z. no. 25,261.] New synonymy.—Dreisbach, 1950, Amer. Midl. Nat., 43: 585, 588.

Pompilinus coruscus var. *juxtus* Bradley, 1946, Mem. Soc. Cubana Hist. Nat., 18: 130.

This widely distributed Tropical and Lower Austral subspecies has gone by a variety of names, as indicated above. In this form the abdomen of the female has the basal three segments almost wholly orange, above and below; the front and often other parts of the body are silvery-sericeous in most cases. Some males have an unusual amount of hair on abdominal sternites four and five, sometimes forming distinct brushes. The genitalia of these specimens, however, are exactly like those of specimens with very little hair on the venter, and this character must be attributed to individual variation.

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[8] The identity of *Pompilus coruscus* Smith, 1855 (Cat. Hymen. Brit. Mus., III, p. 156), of which Cresson considered *juxtus* a variety, has remained something of a mystery to American authors. I have not seen the type, which is in the British Museum, but what I believe to be *coruscus*, judging from the description, belongs to the subgenus *Pompilinus*, and is thus not closely allied to *juxtus*. *Pompilus insignis* Cresson, 1865, which was also made a variety of *coruscus* by Cresson in 1867, is a discrete and very distinctive species, belonging to the *Americanus* species-group of the subgenus *Arachnophroctonus*.

FEMALE.—Length 12.5 (9-17) mm. Color black, the basal three abdominal segments in large part orange; usually all but the extreme base of the first segment and the apical margin of the third are colored, but sometimes the sternites are partly or wholly black; the orange on the third tergite is usually emarginate behind medially. Wings lightly to rather heavily infuscated, with a darker marginal band, sometimes somewhat violaceous. Pubescence in greater part dark, frequently silvery on the front, clypeus, base of the mandibles, and outer orbits; sometimes parts of the thorax and abdomen are also silvery. Other features essentially the same as in the nominate subspecies.

MALE.—Length 8.8. (6.5-11) mm. Color black, the posterior pronotal margin with a buff stripe, the second abdominal segment circled with orange, usually wholly orange with the coloration extending to the adjacent segments. Abdominal sternites 4 and 5 with a variable amount of erect hair, occasionally dense enough to form distinct brushes, but on the other hand sometimes scarcely noticeable. Body often extensively silvery-sericeous, as in the typical subspecies, the apical abdominal tergite especially noticeably silvery. Propodeum sometimes with a few white erect hairs.

Biology.—This form occurs on beaches, stream-banks, and other places where the soil is predominantly sand, clay, or gravel. Males have been taken on desert broom (*Baccharis sarathroides*), desert lavender (*Hyptis emoryi*), and smartweed (*Polygonum* sp.). For notes on the prey and nesting habits, see under *americanus americanus.*

Distribution.—This subspecies ranges from Central America north to central California, Utah, Kansas, Tennessee, and Alabama; it also occurs in Cuba. East of central Texas and Kansas there is much apparent overlap in range with typical *americanus;* in fact, throughout the range of *americanus americanus* specimens occasionally occur which resemble *juxtus,* perhaps wherever ecological conditions simulate those of the usual range of *juxtus.*

Specimens seen: 168 (88 ♀♀, 80 ♂♂). The following records seem to define the northern limits of its range in the United States: ALABAMA: Tuscaloosa Co., 1 ♀, 9 May [HEE]; TENNESSEE: Shelby Co., 1 ♀, Memphis, 16 July [CU]; LOUISIANA: Madison Co., 1 ♀, 1 ♂, Tallulah, Aug. [JEG]; KANSAS: Riley Co., 14 ♀♀, 12 ♂♂, 2 July–16 Oct. [KSC, HEE]; Seward Co., 1 ♀, 18 Aug. [UK]; NEW MEXICO: Dona Ana Co., 2 ♀♀, 5-15 Oct. [ANSP, CIS]; UTAH: Uintah Co., 1 ♀, Vernal, 28 June [UAC]; Wayne Co., 1 ♂, Hanksville, 1 Aug. [UAC]; CALIFORNIA: Calaveras Co., 1 ♀, Jenny Lind, 21 Oct. [CU]; Tulare Co., 1 ♀, 4 ♂♂, May-July [CIS, CU]. Specimens also seen from MEXICO (Baja California, Jalisco, Tamaulipas, and Yucatan), GUATEMALA, HONDURAS, COSTA RICA, PANAMA, and CUBA.

8. **Anoplius (Arachnophroctonus) moestus** (Banks) new combination (Pl. XIII, fig. 86; pl. XVIII, fig. 122.)

Pompiloides moestus Banks, 1912, Jour. N. Y. Ent. Soc., 19: 226. [Type: ♀; Fedor, Lee Co., Tex., April (Birkmann); M.C.Z. no. 13,677.][9]

Psammochares (*Pompiloides*) *moestus* Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.

Anoplius comanche Banks, 1941, Canad. Ent., 73: 121. [Type: ♂; Nueces River, Uvalde Co., Tex., 2 July 1917 (J. Bequaert); M.C.Z. no. 25,262.] New Synonymy.

Although probably most closely related to *americanus,* this species is little apt to be confused with it because of its all-black coloration. It is more likely to be confused with certain species of *Pompilinus;* however, the transverse median vein of the fore wing always meets the media before or at the origin of the basal, never beyond. The male genitalia and subgenital plate are very distinctive.

FEMALE.—Length 12 (9.5-16) mm. Color black; wings lightly to rather heavily infuscated, with a darker marginal band, sometimes slightly violaceous. Body clothed with a fine brownish pubescence, in certain lights obscurely reflecting deep metallic colors, on the lower front and base of the mandibles often cinereous or a bit silvery. Front and vertex with scattered short hairs; pronotum and front coxae a bit hairy; remainder of thorax and the propodeum without more than a very little inconspicuous hair; apical tergite densely bristly.

Clypeus from 2.3 to 2.5 times as broad as high, its apical margin very slightly concave. Front narrow, middle interocular distance about .55 times the transfacial. Inner orbits slightly convergent above, upper interocular distance from .8 to .9 the lower. Ocelli in a right triangle on the narrow vertex; postocellar line: ocello-ocular line about as 5:4. First four antennal segments in a ratio of about 3:1:5:4, segment 3 about equal to the upper interocular distance (.9 to 1.1 times it).

Posterior margin of pronotum distinctly but rather broadly angulate. Propodeum rather short and convex, the declivity nearly flat, the median line not or weakly impressed. Spines of the tarsal comb not much if any longer than the width of the tarsus; basitarsus with 3 comb-spines. Fore wing with the third submarginal cell much narrowed above, triangular or subtriangular.

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[9] A single female paratype from the type locality [MCZ] is an *A.* (*Pompilinus*) *insolens* (Banks), and not *moestus.*

MALE.—Length 9 (7-11) mm. Color black, the posterior pronotal margin occasionally with a pale stripe. Wings hyaline or lightly infuscated, the outer margins with a fuscous band. Pubescence silvery at least on the lower front, base of mandibles, clypeus, and outer orbits, often also over much of the thorax and propodeum; pubescence of the abdomen dark, obscurely reflecting deep metallic colors. Clypeus, front, and vertex with sparse short hairs; thorax and propodeum with at most only a very small amount of inconspicuous hair; abdominal sternites 2 through 6 each with a few hairs, and sternites 4 through 6 each with a patch of short, suberect hairs near the base, forming inconspicuous short brushes; subgenital plate covered rather densely with erect setae of moderate length.

Clypeus about twice as broad as high, its apical margin truncate. Front of moderate breadth, the middle interocular distance from .58 to .60 times the transfacial distance. Upper interocular distance subequal to or very slightly greater than lower interocular distance. Ocelli forming a right or acute angle in front, the postocellar line subequal to or a little greater than the ocello-ocular line. First 4 antennal segments in a ratio of about 3:1:3:3, segment 3 a little more than twice as long as thick. Posterior pronotal margin broadly angulate. Median line of propodeum weakly if at all impressed. Last segment of front tarsus slightly produced on the inner side. Venation much as in the female, the 2d submarginal cell only a little if any broader than high, the 3d submarginal often petiolate.

Abdomen slender, subcylindrical; venter hairy as described above. Sternite 6 with a median U-shaped emargination behind. Subgenital plate (Fig. 122) rather broad near the base, tapering to a subacute apex; disc nearly flat, dark-pigmented and provided with numerous perpendicular hairs along a median band, on the sides with only short setae and almost unpigmented. Genitalia (Fig. 86) much like those of *americanus*; parameres slender, with a few strong setae along the lower inner margin and most of the outer margin; volsellae with several strong setae on the base, the digiti somewhat spindle-shaped and clothed all over with rather long hairs which are angled near their apices; parameres slender, slightly curved; aedoeagus broadest subapically, simple.

Biology.—This species has been collected on the flowers of *Asclepias, Ampelopsis arborea, Tamarix gallica,* and *Bifora americana.* Collection dates vary from 21 April to 6 December.

Distribution.—This is a Lower Sonoran form, ranging from the Mexican states of Coahuila and Chihuahua north to southeastern Arizona, southern New Mexico, southern Kansas, and eastern Texas.

Specimens seen: 52 (30 ♀♀, 22 ♂♂). KANSAS: Reno Co., 2 ♀♀, 18 June [HEE]; TEXAS: Bexar, Brazos, Collin, Dallas, Eastland, Hunt, Jeff Davis, Lee, Mitchell, Nueces, Presidio, Travis, Uvalde, Victoria, Webb, and Williamson Cos., numerous specimens [CU, HEE, JEG, MCZ, RWS, USNM, UK]; NEW MEXICO: Dona Ana Co., 1 ♂, Las Cruces, 3 July [UK]; ARIZONA: Cochise Co., 2 ♂♂, Douglas, 7-24 July [UK, USNM]; 2 ♂♂, 2 mi. E. of Pearce, 9 Aug. [HEE]; MEXICO: Chihuahua, 1 ♀, Villa Allende, 6 Dec. [Minn.]; Coahuila, 1 ♀, Buena Vista, Sierra del Carmen, 6000 feet, 22 July [JEG].

E. Subgenus **POMPILINUS** Ashmead

Psammochares Latreille, 1796, Précis des Caractères générique des Insectes, p. 115. [Type: *Sphex fusca* Linnaeus, 1761; designated by Latreille, 1803.] (See further remarks under the generic heading.)

Pompilus Fabricius, 1798, Suppl. Ent. Syst., pp. 212 and 246-252. [Type: *Pompilus viaticus* Fabricius, 1798 (=*Sphex fusca* Linnaeus, 1761); designated by Latreille, 1810.] (See further remarks under the generic heading.)

Pompilinus Ashmead, 1902, Canad. Ent., 34: 85. [Type: *Pompilus cylindricus* Cresson, 1867; monobasic.]—Banks, 1939, Canad. Ent., 71: 225. —Dreisbach, 1949, Ent. Amer., (n. s.) 29: 1-58. [Revision of males of North American species.]

Pompiloides Banks, 1912, Jour. N. Y. Ent. Soc., 19: 221, 223, 226. [*Pro Pompilioides* Radoszkowski, 1887, *nec* Radoszkowski.]—Banks, 1917, Bull. Mus. Comp. Zool., 61: 107, 108.—Banks, 1919, Bull. Mus. Comp. Zool., 63: 235-236.

Anopliella Banks, 1939, Canad. Ent., 71: 225, 227. [Type: *Pompilus tenebrosus* Cresson, 1865; original designation.]—Dreisbach, 1950, Amer. Midl. Nat., 42: 722. [Placed in synonymy with *Pompilinus*.]

This exceedingly homogeneous group may have arisen as a development of a single line within the subgenus *Arachnophroctonus*. Its members closely resemble those of the *Americanus*-group of that subgenus, the only reliable difference being that in *Pompilinus* the transverse median vein of the fore wing meets the media beyond the origin of the basal. The parameres of the male genitalia of *Pompilinus* are normally considerably broadened apically, rather than being slender throughout or broadest near the base, as in the other subgenera of *Anoplius*. However, in *subcylindricus* and its allies the parameres are slender throughout; furthermore, in these species the transverse median and basal veins are occasionally interstitial, and the male venter shows a tendency to have short brushes of hair, rather than being completely smooth as in most

Pompilinus. The *Subcylindricus* species-group appears to be annectant between *Pompilinus* and *Arachnophroctonus,* and might be included in the latter group by a slight shifting of the weight given the various characters used in their definition. In fact, it is not certain whether these two groups will stand as discrete subgenera, in the final analysis, unless further characters are discovered to separate them.

The most frequently used "key" character for this subgenus is the usually petiolate third submarginal cell of the fore wing. However, this character is not diagnostic by itself, as a number of other Pompilini also possess it. In most of the species the spines of the tarsal comb are very short; in many of the species the propodeum is without erect hairs. Because of the great similarity among the numerous species of *Pompilinus,* combined with a not inconsiderable amount of intraspecific variation, the group is one of the most difficult in the tribe. The male terminalia provide almost the only clear-cut characters, and for the accurate identification of most of the species a careful study of the genitalia and subgenital plate is necessary. Of course, like all other morphological features, these are subject to individual variation. Failure to recognize this fact has led to the creation of many new synonyms recently by Dreisbach (1949). The present treatment of this subgenus is, I am well aware, by no means the last word on the subject. Particularly needed in this group are careful field studies on the various species, in order to more accurately associate the sexes, and to discover facts in their biology which may enable us to more clearly define the species.

Subgeneric characters.—Small wasps, 3 to 15 mm. in length; color black, in some species the basal abdominal tergites marked with orange. Pubescence very fine, predominantly fuscous, in the males of most of the species extensively silvery. Body usually relatively devoid of erect hairs; propodeum at most moderately hairy, usually not at all so; male venter practically devoid of erect hairs, except that in a few species there are mats of short hair on some of the sternites; pygidium of female always conspicuously bristly.

Mandibles of male unidentate, those of the female bidentate, but the inner tooth often reduced or worn so that they seem to be unidentate. Apical margin of clypeus truncate, only in the female *fraternus* somewhat emarginate. Front and vertex of very variable breadth; antennae slender, of variable length. Tarsal comb of female present, the spines usually not longer than the width of the tarsus, never more than twice that length. Last segment of front tarsus of male distinctly asymmetrical, with an expansion on the inner margin, the segment widest about half-way from base to apex. Inner claw of front tarsus of male strongly curved, deeply cleft, the inner ray acute; outer claw of this tarsus slightly more strongly curved than the claws of the other tarsi. Pulvillar comb of female with from 10 to 20 setulae, in the male much less well developed. Hind femora of male compressed. Propodeum of male nearly flat in front, distinctly more declivous behind (Fig. 151).

Cubitus of hind wing meeting the media at or beyond the tip of the submedian cell. Transverse median vein of fore wing meeting the media almost always distinctly beyond the origin of the basal. Stigma short; marginal cell rather small, always more than its length from the wing-tip, the radial vein always somewhat angled at the third transverse cubital vein. Second submarginal cell 4-sided, seldom much broader than high, sometimes higher than broad; third submarginal cell usually petiolate above, sometimes not so, the 2d and 3d transverse cubital veins rarely not meeting above. (Wings of one species shown in Fig. 153.)

Abdomen of the male very slender, cylindrical, elongate; venter smooth, or in a few species with mats of short or moderately long suberect setae on one or more of the sternites. Emargination of sternite 6 well defined, narrow. Subgenital plate with the basal sclerite slender, V-shaped, the plate itself variously shaped, flat or with the median line elevated. Genitalia with the parameres broader apically than near the base, except in a few species, the squamae usually evident. Basal hooklets strong, simple, the upper margin not strongly arched. Digiti variously modified and showing excellent specific characters. Parameres simple, slender, embracing the simple, usually slender aedoeagus.

Biology.—The species of this subgenus, some of which are very common, are predominantly inhabitants of sandy areas; in most areas extensive collecting in a single sand-pit or barren area will turn up several species. Most of the species also come regularly to flowers, especially Umbelliferae.

So far as known, the species of *Pompilinus* are remarkably unselective in their spider prey. For example, *marginatus* is known to prey upon spiders belonging to seven different families and many different modes of life, as well as on Phalangids. The European *fuscus* is known to prey upon spiders of five different families. Lycosidae are most commonly taken; I have seen *marginatus,* however, actually enter the web of an orb-weaver in search of prey, and on another occasion took it with a specimen of the golden garden spider, *Argiope aurantia.* This species is also known to enter the burrows of subterranean spiders. The nest is a simple burrow with a terminal cell constructed in sand or soft earth. Richards and Hamm[10] have compiled the rather considerable information available regarding the habits of the common European species *fuscus* L. What is known about the biology of our native species is summarized under the various species.

Distribution.—This subgenus appears to be distributed throughout the range of the genus *Anoplius,* but is nowhere so well represented as in the Nearctic region, where there are 17 species.

Key to Species

Females

(The females of four species are unknown.)

1. Body entirely black or blue-black 2
   Body marked with rufous, orange-brown, or yellowish-brown on one or more of the basal abdominal tergites 10
2. Head, in anterior view, with the vertex distinctly elevated in an arc above the tops of the eyes (as in Fig. 158); very small species 3
   Head, in anterior view, with the vertex extending straight across at or slightly above the eye-tops (as in Figs. 156 and 157); small or medium-sized species 5
3. Posterior margin of pronotum arcuate or at most with a very feeble angulation ....2. **subcylindricus** (Banks)
   Posterior margin of pronotum forming a distinct, though often broad, angulation 4
4. Temples strongly developed, in lateral aspect about two-thirds the width of the eye; propodeum usually with some short erect hairs on the sides 8. **estellina** (Banks)
   Temples narrow, not more than half the width of the eye; propodeum not at all hairy ....3. **percitus** Evans
5. Body rendered by the pubescence a rich deep blue (fading to violet in older specimens); third antennal segment equal to from .9 to 1.0 times the upper interocular distance ....1. **grandiflexionis** Evans
   Body dull black, the pubescence at most rather obscurely violaceous (in doubtful cases the third antennal segment equal to less than .9 the upper interocular distance) 6
6. Propodeum bearing numerous prominent erect hairs, at least dorsolaterally; head and thorax with considerable erect hair 7
   Propodeum not at all hairy or with only a few very short, fine, scarcely noticeable hairs on the sides 8

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[10] Richards, O. W., and A. H. Hamm, 1939, Trans. Soc. Brit. Ent., 6: 90-96.

7. Tarsal comb strong, the spines usually longer than the thickness of the tarsus, the basitarsus with either three or four comb-spines.
7. **californiae** Evans

Spines of the tarsal comb not or scarcely longer than the width of the tarsus, the basitarsus always with three comb-spines.
9. **tenebrosus** (Cresson)

8. Front of moderate breadth, distinctly wider than the eyes taken together, the middle interocular distance varying from .57 to .60 times the transfacial distance (Fig. 157) ....10. **insolens** (Banks)

Front narrow, only a little wider than the eyes taken together, the middle interocular distance varying from .53 to .56 times the transfacial distance (as in Fig. 156) 9

9. Propodeum rather long, the slope low, the declivity not well defined; apical margin of clypeus slightly excavated; Eastern states, Florida to New Jersey ....5. **krombeini** Evans

Propodeum shorter, the declivity rather well defined and steeply sloping; apical margin of clypeus truncate or very slightly concave; Texas and Kansas westward ....11. **clystera** (Banks)

10. Apical margin of clypeus distinctly emarginate medially; propodeum somewhat hairy ....17. **fraternus** (Banks)

Apical margin of clypeus truncate or very slightly concave; propodeum hairy or not 11

11. Propodeum rather long, in full dorsal view as long as its greatest breadth, in lateral view (Fig. 162) with the slope low, the declivity not well defined; first two abdominal tergites marked with orange; antennae long and slender, the outer segments all more than three times as long as thick ....16. **splendens** (Dreisbach)

Propodeum shorter, in full dorsal view not as long as broad, in lateral view (Fig. 161) with the dorsum more arched, the declivity better defined (in doubtful cases, antennal segments 7-10 each less than three times as long as thick); first abdominal tergite marked with orange or not 12

12. Front and vertex very broad, the middle interocular distance at least .6 the transfacial distance; propodeum at least a little hirsute on the sides; tarsal comb variable, often stronger than below, the basitarsus with three or four comb-spines ....6. **cylindricus** (Cresson)

Front and vertex of moderate breadth, the middle interocular distance less than .6 the transfacial; propodeum not at all hairy; spines of the tarsal comb not longer than the width of the tarsus, the basitarsus with three comb-spines ....15. **marginatus** (Say)

Males

1. Abdominal sternite 4 with a dense patch of setae, visible at least under high magnification; parameres of genitalia slender throughout, except in two species in which the hair-brush on the fourth sternite is very conspicuous (*Subcylindricus*-group) 2

Abdominal venter without a patch of setae on any of the sternites, at most with a few scattered weak hairs, or some short setae on sternites 6 or 7; parameres usually broader distally than near the base (*Cylindricus*-group) 6

2. Larger, over 10 mm.; posterior margin of the pronotum with a pale stripe; upper, outer margin of digitus volsellaris without very long hairs ....1. **grandiflexionis** Evans

Smaller, 4 to 9 mm.; wholly black; upper, outer margin of digitus with a group of very long hairs 3

3. Third antennal segment not more than 2.3 times as long as its greatest thickness, and a little shorter than the scape; digitus volsellaris with a group of small setae on the inner margin at and just below the apex ..4

Third antennal segment very slender, at least 3 times as long as its greatest thickness, at least as long as the scape; digitus without a group of setae in this position 5

4. Brush of hairs on the fourth sternite very short, often seen with difficulty; subgenital plate fairly broad (Fig. 125); parameres slender throughout (Fig. 88) ....2. **subcylindricus** (Banks)

Brush of hairs on the fourth sternite prominent, long; subgenital plate very narrow (Fig. 128); parameres broadened apically (Fig. 155). 4. **texanus** (Dreisbach)

5. Third antennal segment very slightly longer than the fourth; brush of hairs on the fourth sternite not prominent; parameres slender; digiti clothed mostly with minute setae (Fig. 89) ....3. **percitus** Evans

Third antennal segment about as long as the fourth; brush of hairs on the fourth sternite prominent, long; parameres expanded apically; digiti of different shape than above and clothed densely with fairly long hair (Fig. 90) ....5. **krombeini** Evans

6. Subgenital plate (Fig. 135) completely flat, the disc with two feeble carinae which converge slightly behind, the apex evenly rounded; digiti (Fig. 94) rounded apically ....9. **tenebrosus** (Cresson)

Subgenital plate of different form, generally somewhat elevated medially, the apex usually acute or subacute, the disc never with paired carinae; digiti never evenly rounded apically 7

7. Hind basitarsus on the inner side for its entire length beset with short, erect hairs (Fig. 165); genitalia as shown in Fig. 97. 15. **marginatus** (Say)

Hind basitarsus with erect setae only for a short distance basally, near the spurs 8

8. Subgenital plate (Fig. 137) unusually slender throughout; parameres (Fig. 104) attenuate apically, the apex and areas along the inner and outer margins toward the apex almost unpigmented, membranous; abdomen always marked with rufous ....17. **fraternus** (Banks)

Subgenital plate much less slender; parameres without such membranous areas; marked with rufous or not 9

9. Propodeum, and usually the mesopleura and middle and hind coxae, somewhat hairy; genitalia as shown in Fig. 92, the digiti elongate-fusiform, the aedoeagus rather broadly expanded apically. 7. **californiae** Evans

Propodeum, mesopleura, and middle and hind coxae not or very scarcely hairy; genitalia of different structure, the aedoeagus more narrowly expanded apically 10

10. Subgenital plate (Fig. 123) tapering gradually to a more or less acute tip, usually rather strongly hirsute ventrally; genitalia (Fig. 91) with the digiti more or less truncate apically, the parameres slender basally and with the squamae unusually prominent .. 6. **cylindricus** (Cresson)

Subgenital plate either obtusely pointed apically, or broadly rounded and with the median point acute; digiti not squarely truncate apically 11

11. Subgenital plate (Fig. 136) obtusely pointed, the disc a little convex in cross-section, but the median line not sharply elevated; parameres (Fig. 95) broad nearly to the apex, which is subtruncate. 10. **insolens** (Banks)

Subgenital plate with the median line distinctly elevated above the rest of the disc, the apex not tapered gradually to an obtuse angle; genitalia not as in Fig. 95 12

12. Subgenital plate (Figs. 131 and 132) with broad side-pieces completely devoid of even minute setae; digiti often without long setae on the upper, outer margin 13

Subgenital plate (Figs. 130 and 134) clothed completely, at least on the apical half, with at least minute setae; digiti with some setae on the upper, outer margin, which are almost always longer than those on the remainder of this appendage 16

13. Parameres (Figs. 98 and 99) devoid of setae along their inner margins ventrally except for a few short ones just above the squamae; digiti more or less spindle-shaped, the outer margin arched gradually to the apex 14

Parameres (Figs. 100 and 101) clothed ventrally along the inner margin with prominent long setae; digiti elongate, the apex more or less obliquely truncate 15

14. Digiti not carinate subapically, the upper, outer portion with some moderately long, straight hairs; parameres a little longer along the inner margin than the outer, the apex somewhat acute (Fig. 98). 13a. **stenotus stenotus** (Banks)

Digiti with a short carina near the outer margin just below the apex, more or less devoid of setae in this area; parameres more or less rounded apically (Fig. 99) ......13b. **stenotus bequaerti** (Dreisbach)

15. Digiti tapering on their apical one-third to a somewhat acute apex; parameres nearly straight, much exceeding the other appendages (Fig. 100) ....12a. **rectangularis rectangularis** (Dreisbach)

Digiti with an oblique truncation on their apical one-sixth, the apex less acute; parameres slightly shorter and more curved than above (Fig. 101) ....12b. **rectangularis gillaspyi** new subspecies

16. Aedoeagus (Fig. 93) with a marked, abrupt apical expansion; basis volsellaris with some very long setae; digiti elongate.
8. **estellina** (Banks)

Aedoeagus only slightly expanded apically; basis volsellaris with only some very short, weak setae 17

17. Parameres strongly curved, tapering to a slender, acute apex; digiti clothed sparsely with rather soft hairs, and with a number of long hairs at the upper, outer margin (Fig. 103).
16. **splendens** (Dreisbach)

Parameres somewhat curved, the apex much less slender and tapering; digiti clothed on the disc with close-set, rather stiff hairs which are angled at their apices 18

18. Parameres gradually expanded nearly to the apex, which is rather abruptly, obliquely truncate; digiti broadest about half-way out, thereafter narrowed gradually to the apex (Fig. 102).
14. **townesi** new species

Parameres gradually widened to about the middle, thereafter narrowed to the apex; digiti gradually expanded to a point just below the apex, thereafter abruptly contracted, almost truncate (Fig. 96)
11. **clystera** (Banks)

Subcylindricus Species-group

In this group are placed five species in which the male venter bears a short to moderately long brush of hairs on the fourth abdominal sternite. The parameres of the genitalia are slender and nearly linear, except in two species in which they are somewhat expanded apically. In this group the basal and transverse median veins of the fore wing are occasionally interstitial. All of these characters suggest a linkage of this group with the *Americanus*-group of the subgenus *Arachnophroctonus.* None of the species of this group are marked with rufous.

1. **Anoplius (Pompilinus) grandiflexionis** Evans

(Pl. XIII, fig. 87; pl. XIX, fig. 124.)

Anoplius (*Pompilinus*) *grandiflexionis* Evans, 1950, Jour. Kansas Ent. Soc., 23: 84-85, 87, figs. 1 and 2. [Type: ♂; Fort Davis, Texas, 26 July 1946, on dried leaves in an arroyo (H. E. Evans); U.S.N.M. no. 59,474.]

The rich bluish pubescence of this species sets it apart at once; the species superficially resembles *A.* (*Anoplius*) *ventralis tarsatus* Banks. Of the species of *Pompilinus* this probably stands closest to *Arachnophroctonus,* as evidenced by the pale stripe on the pronotum of the male, and particularly the genitalia, which suggest *moestus* and *americanus.* The species is known at present from only seven specimens.

FEMALE.—Length 11.5 (10-13) mm. Color black, the body rendered a rather conspicuous deep bluish (fading to violet in older specimens) by the pubescence. Wings fuscous, a little darker along the outer margin, violaceous. Front, vertex, and front coxae with numerous dark setae; pronotum, mesonotum, scutellum, mesopleura, and sides of the propodeum very slightly hairy.

Clypeus about 2.6 times as broad as high, its apical margin truncate. Front rather narrow, the middle interocular distance varying from .52 to .56 times the transfacial distance. Inner orbits converging slightly above, the upper interocular distance about .85 times the lower. Ocelli forming an acute angle in front; postocellar and ocello-ocular distances about equal. First four antennal segments in a ratio of about 6:2:9:7, segment 3 equal to from .9 to 1.0 times the upper interocular distance.

Posterior margin of the pronotum feebly angulate. Propodeum short, with a somewhat flattened declivity behind. Mesosternum acutely produced over the inner bases for the middle coxae, with a V-shaped emargination between the processes. Spines of the tarsal comb about as long as the thickness of the tarsus; basitarsus with 3 comb-spines. Fore wing with the third submarginal cell triangular, sometimes petiolate.

MALE.—Length 11.5 mm. Color black, the posterior margin of the pronotum with a buff-colored stripe, interrupted medially. Clypeus, lower front, temples, and greater part of the thorax and propodeum with fine silvery pubescence; pubescence of the dorsal parts of the head and thorax, and the entire abdomen, dark bluish. Front with considerable black erect hair; abdominal sternites four and five clothed with a mat of very short, suberect setulae. Wings hyaline, the outer margins broadly and conspicuously infuscated.

Clypeus 2.2 times as broad as high, its apical margin truncate. Middle interocular distance about .6 the transfacial; upper interocular distance very slightly greater than the lower. Ocelli rather large, in a right triangle, the postocellar and ocello-ocular lines about equal. Antennae slender, the first four segments in a ratio of about 3:1:3:3, segment 3 about 3.2 times as long as thick. Pronotum feebly angulate behind; propodeum with a faintly impressed median line. Third submarginal cell of the fore wing petiolate.

Abdomen long, cylindrical, without long erect hairs, but sternites 4 and 5 with mats of very short hairs, visible on close inspection. Sternite 6 with a broadly V-shaped emargination. Subgenital plate of moderate breadth, the apex broadly rounded, the median line not elevated (Fig. 124), very similar to that of *A.* (*Arachnophroctonus*) *americanus.* Genitalia (Fig. 87) with the parameres long, slender, slightly curved, sparsely clothed with setae. Basis volsellaris with two very long setae; digitus somewhat triangular, clothed with setae which are longest at the outer angles. Parapenials simple, slender, embracing the rather broad aedoeagus, which is weakly bilobed apically.

Biology.—I have taken several specimens of this species in dry stream-beds beneath trees, and one female on the flowers of *Sphaeralcea angustifolia.*

Distribution.—This species inhabits the Upper Sonoran fauna of New Mexico and western Texas.

Specimens seen: 7 (6 ♀♀, 1 ♂). TEXAS: Brewster Co., 1 ♀, Chisos Mts., 5400 feet, 8-14 July (H. E. Evans) [ANSP]; Jeff Davis Co., 2 ♀♀, 1 ♂, Fort Davis, 5000 feet, 26 July (H. E. Evans) [USNM, HEE]; 1 ♀, 6-10 mi. W. of Fort Davis, 15-23 July (H. E. Evans & G. E. Ball) [CAS]; NEW MEXICO: Sandoval Co., 2 ♀♀, Jemez Springs, 21 July, 7 Aug. (J. Woodgate) [CU, MCZ].

2. **Anoplius (Pompilinus) subcylindricus** (Banks)
(Pl. XIII, fig. 88; pl. XIX, fig. 125.)

Pompiloides subcylindricus Banks, 1917, Bull. Mus. Comp. Zool., 61: 103. [Type: ♀; Falls Church, Va., Aug., on tulip tree honeydew (N. Banks); M.C.Z. no. 10,015.][11]

Psammochares (*Pompiloides*) *subcylindricus* Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 124, 126. [Raleigh, N. C.]

Pompilinus cylindricus Dreisbach, 1949, Ent. Amer., (n. s.) 29; 27, 31, 36, pl. II, figs. 9 and 10. [*Nec* Cresson, 1867; misidentification.]

Anoplius (*Pompilinus*) *subcylindricus* Krombein, 1950, Jour. Elisha Mitchell Sci. Soc., 65: 264.

This is one of the more common species of the subgenus east of the Rockies. The female may be recognized by its small size and arcuate posterior pronotal margin. The male is very similar to the species which follows, and care must be taken in observing the characters indicated in the key for separating these species. The brush of hairs on the fourth abdominal sternite of this species is very short, and in some specimens very difficult to observe.

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[11] Banks' paratypes [MCZ] consist of this and four other species, belonging to two genera and three subgenera.

FEMALE.—Length 7.3 (5.5-9.5) mm. Color black; wings lightly to moderately infuscated, usually a bit darker along the outer margin. Pubescence wholly dark, often somewhat violaceous, sometimes rather strongly so. Clypeus, front, and vertex with fairly abundant short, dark hair; pro- and mesonota, scutellum, and coxae usually a little hairy; propodeum with not more than a very small amount of inconspicuous hair on the sides.

Clypeus 2.5 to 2.7 times as broad as high, its apical margin truncate. Front very broad, the middle interocular distance from .60 to .65 times the transfacial distance. Inner orbits somewhat convergent at the top, the upper interocular distance from .85 to .95 times the lower. Vertex arched slightly above the tops of the eyes. Ocelli forming a right or obtuse angle in front, the postocellar line often slightly greater than the ocello-ocular. Antennae rather short, the first four segments in a ratio of about 3:1:3.8:3.3, segment 3 never longer than 1 plus 2, and equal to from .54 to .7 times the upper interocular distance. Temples rather strongly developed, in lateral view roughly half the width of the eye.

Posterior margin of pronotum arcuate or at most with a very vague median angulation. Propodeum short and convex, with a well-defined slightly concave declivity behind. Spines of tarsal comb short, about as long as the thickness of the tarsus; basitarsus with 3 comb-spines. Fore wing with the transverse median and basal veins sometimes interstitial, more often slightly to rather strongly disjointed. Third submarginal cell triangular, nearly always petiolate.

MALE.—Length 7 (4.5-9) mm. Color black; wings hyaline or nearly so, the outer margins with a fuscous band. Greater part of the head and thorax conspicuously silvery-sericeous, especially the lower front, coxae, and propodeum. Front and vertex with scattered short hairs; pronotum and front coxae a bit hairy; abdominal sternite 4 with a dense mat of very short, suberect setae, and to a lesser extent usually sternite 5 (considerable magnification is needed to see this).

Clypeus about 2.2 times as broad as high, truncate below. Front broad, the middle interocular distance varying from .61 to .67 times the transfacial distance; upper interocular distance subequal to or a little greater than the lower. First four antennal segments in a ratio of about 25:10:24:25, segment 3 from 1.9 to 2.2 times as long as its greatest thickness. Pronotum moderately long, with a steep anterior slope and a nearly flat portion behind; posterior margin arcuate or with a vague median angulation. Propodeum with an impressed median line, its surface nearly flat in front, rather steeply declivous behind.

Venter with short, inconspicuous mats of hair on the 4th and 5th sternites. as described above. Sternite 6 with a narrow, U-shaped emargination. Subgenital plate rather narrow, nearly parallel-sided, the apex rounded or obtusely pointed, the median line strongly though not sharply elevated; surface of the plate clothed with very short setulae (Fig. 125, the plate sometimes more narrow than figured). Genitalia (Fig. 88) with the parameres slender (occasionally not quite as slender as shown in figure), curved slightly, the squama fairly strong. Volsella with one or a few hairs of moderate length on the basis; digitus large, subfusiform, the inner margin nearly straight, the outer margin arched, the apex acuminate; most of the disc of the digitus is clothed with small setae which are angled near the tips, but along the inner margin near and at the apex is a series of slightly longer, straight hairs, and on the upper outer margin is a series of very long hairs which are more or less sinuate apically. Parapenials slender, nearly straight. Aedoeagus gradually and evenly broadened toward the apex, where it is abruptly truncate.

Biology.—This species is a characteristic inhabitant of small sandy or gravelly areas. I have taken a female with the spider *Xysticus gulosus* Keys. (Thomsidiae) [det. B. J. Kaston], which it was dragging backward in a sand pit near Ithaca, N. Y. Both sexes visit flowers, especially those of umbelliferous plants such as *Pastinaca sativa, Daucus carota,* and *Conium maculatum;* it has also been taken on *Solidago, Ceanothus, Baccharis, Polytaenia nuttallii, Sphaeralcea angustifolia, Melilotus alba, Euphorbia marginata, Hymenopappus corymbosus, Lepidium densiflorum,* and *Bifora americana.* Collection dates range from June to September in the northern parts of the range, April to October in the South.

Distribution.—This species ranges from the Lower Austral to the Transition Zones, from Florida and northern Mexico to Utah, North Dakota, Michigan, and Quebec.

Specimens seen: 300 (221 ♀♀, 79 ♂♂). The following records appear to define the periphery of the range: New Hampshire: Rockingham Co., 1 ♂, Hampton, 24 June [USNM]; Quebec: 1 ♀, Val Morin, July [CU]; 2 ♂♂, Kazabazua, July [CNC]; Ontario: 4 ♀♀, Jordan, 24 Aug.-7 Sept. [CNC]; Michigan: Cheboygan Co., 1 ♂ [UK]; Minnesota: Clearwater Co., 1 ♀, Itasca Park, 8 July [Minn.]; North Dakota: LaMoure Co., 1 ♀, Edgeley, 23 June [Minn.]; Nebraska: Nance Co., 1 ♂, Genoa, 10 Sept. [CU]; Kansas: Pratt Co., 1 ♀ [UK]; New Mexico: Colfax Co., 1 ♂, Raton, 13 Aug. [HEE]; Utah: Uintah Co., 1 ♀, Ft. Duchesne, 14 July [MCZ]; Kane Co., 1 ♀, Orderville, 14 Aug. [HEE]; Mexico: 1 ♀, Meadow Valley [USNM]; Texas: Webb Co., 1 ♀, Laredo, 24 Sept. [JEG]; Victoria Co., 2 ♀♀, 16 June [HEE]; Alabama: Mobile Co., 3 ♀♀, 2 ♂♂, Creola, 3 Apr. [HEE]; Florida: 1 ♀, St. Nicholas [USNM].

3. **Anoplius (Pompilinus) percitus** Evans

(Pl. XIII, fig. 89; pl. XIX, fig. 125; pl. XXII, fig. 158.)

Pompilinus subcylindricus Dreisbach, 1949, Ent. Amer., (n. s.) 29: 31, 42, pl. V, figs. 25, 26. [*Nec* Banks; misidentification.]

Anoplius (*Pompilinus*) *percitus* Evans, 1950, Jour. Kansas Ent. Soc., 23: 85-88. [Type: ♂; Ithaca, N. Y., on sand, 27 July 1947 (H. E. Evans); U.S.N.M. no. 59,475.]

This species is very closely allied to the preceding. In the male the third antennal segment is more elongate, and the genitalia lack the group of small hairs at the tip of the digitus; the aedoeagus is also of very different shape. In both sexes the posterior margin of the pronotum is distinctly angulate.

FEMALE.—Length 7.5 (6-9.5) mm. Color black; fore wings lightly infuscated, darker beyond the cells; hind wings nearly hyaline, darker apically. Pubescence wholly brownish-cinereous. Front and vertex with sparse short setae; pronotum and front coxae slightly hairy; remainder of thorax, and the propodeum, practically without erect hair.

Head rather broad, the vertex raised slightly, arcuately above the tops of the eyes (Fig. 158). Clypeus about 2.7 times as broad as high, truncate below. Front very broad, the middle interocular distance varying from .60 to .64 times the transfacial distance. Eyes very slightly convergent above, the upper interocular distance about .95 times the lower. Ocelli in a right triangle, the postocellar and ocello-ocular distances about equal. First four antennal segments in a ratio of about 8:3:10:9, segment 3 equal to from .55 to .8 times the upper interocular distance. Front, in lateral view, strongly convex; temples about half the width of the eyes.

Posterior margin of the pronotum broadly but distinctly angulate. Propodeum short and convex, with an oblique, slightly concave posterior declivity. Spines of the tarsal comb about as long as the width of the tarsus; basitarsus with 3 comb-spines. Marginal cell of the fore wing nearly twice its own length from the wing-tip. Second submarginal cell usually a little higher than broad; third submarginal petiolate.

MALE.—Length 6.5 (5-8.5) mm. Color black; wings hyaline, the fore wing with a broad fuscous band along the outer margin. Pubescence brownish-cinereous, grading into silvery on the front, clypeus, coxae, a large part of the thorax, and the propodeum. Front, vertex, and front coxae very slightly hairy; fourth and to a lesser extent the fifth abdominal sternites with dense mats of short, suberect setae.

Clypeus slightly more than twice as broad as high, its apical margin truncate. Front broad; upper interocular distance subequal to or slightly greater than the lower interocular. Ocelli in a right triangle, the postocellar line equal to or slightly greater than the ocello-ocular. Antennae slender, the first four segments in a ratio of about 9:4:10:9, the third segment thus slightly longer than the fourth, and about three times as long as thick. Posterior pronotal margin angulate. Median line of propodeum lightly impressed. Wing venation as in the female.

Abdominal sternite 6 with a V-shaped emargination. Subgenital plate (Fig. 126) rather narrow, its median line somewhat elevated, the disc clothed with short, suberect setulae. Genitalia (Fig. 89) with the parameres slender, curved. Basis volsellaris with several setae, one of which is very long; digitus with the inner margin nearly straight, the outer margin strongly arched, the apex acute but less attenuate than in *subcylindricus*, and without the short setae on the tip as in that species; disc of the digitus clothed with small setae, the upper outer margin with several long setae which are only slightly sinuous apically. Aedoeagus with its sides arcuately expanded to a point about three-fourths the distance to the apex, then narrowed, the apex feebly bilobed.

Biology.—I have taken this species on sand at the same time and place as *subcylindricus, rectangularis,* and *marginatus,* all members of this same subgenus. It has also been taken on the flowers of *Pastinaca sativa, Daucus carota, Anaphalis margaritacea,* and *Solidago* spp., and on a tulip tree which was dripping honeydew.

Distribution.—This wasp ranges from Texas and Alabama to Colorado, Kansas, Michigan, New York, and Massachusetts, chiefly in the Carolinian and Alleghanian faunas.

Specimens seen: 109 (76 ♀♀, 33 ♂♂). The following records appear to be marginal: MASSACHUSETTS: Suffolk Co., 1 ♀, Boston, 30 Aug. [CAS]; Hampshire Co., 2 ♀♀, 1 ♂, Amherst [Mass.]; NEW YORK: Essex Co., 1 ♀, Mt. McIntyre, 27 Aug. [CU]; Tompkins Co., 2 ♀♀, 2 ♂♂, Ithaca, 5 July-10 Aug. [CU, USNM]; Chautauqua Co., 1 ♀, Bemus Point, 15 July [CU]; PENNSYLVANIA: Allegheny Co., 1 ♀, Pittsburgh, July [CM]; MICHIGAN: Midland Co., 1 ♀, 28 Aug. [Coll. R. R. Dreisbach]; KANSAS: Riley Co., 4 ♀♀, 1 ♂, Manhattan, July, Oct. [HEE, KSC]; COLORADO: Jefferson Co., 1 ♀, Plainview, 9-14 July [MCZ]; TEXAS: Brazos Co., 1 ♀, 1 ♂, 10 Oct. [JEG]; ALABAMA: Tuscaloosa Co., 1 ♀, 4 Oct. [HEE]; VIRGINIA: Fairfax Co., 2 ♀♀, 5 ♂♂, Dunn Loring, 28 Aug.-5 Sept. [KVK].

4. **Anoplius (Pompilinus) texanus** (Dreisbach) new combination

(Pl. XIX, fig. 128; pl. XXI, fig. 155.)

Pompilinus texanus Dreisbach, 1949, Ent. Amer., (n. s.) 29: 14-15, 31, 46, pl. VII, fig. 37 (but *not* fig. 36). [Type: ♂; Lee Co., Texas, May 1907 (Birkmann); M.C.Z.]

This species resembles the preceding two in the shape of the digitus volsellaris, but the parameres are broadened apically much as in *krombeini,* and the brush of hair on the fourth abdominal sternite is prominent as in that species. The very slender subgenital plate sets it apart from other members of this species-group.

Female.—Unknown.

Male.—Length 7 (5.5-8) mm. Color black; wings subhyaline, the outer margin of the fore wing and apex of the hind wing broadly infuscated. Greater part of the head, thorax, and propodeum conspicuously silvery-sericeous; pubescence of the vertex, mesonotum, metapleura, and legs beyond the coxae, brownish-cinereous; abdomen obscurely silvery on the basal tergites, elsewhere brownish-pubescent. Front, vertex, temples, propleura, and anterior coxae with scattered short hairs; abdominal sternite 4 with a dense brush of moderately long hairs, longest behind; subgenital plate rather hirsute.

Clypeus about 2.2 times as broad as high, truncate below. Middle interocular distance about .59 times the transfacial; upper interocular distance slightly greater than the lower. Ocelli in about a right triangle; postocellar line slightly greater than ocello-ocular. First 4 antennal segments in a ratio of about 28 : 10 : 25 : 25, segment 3 a little more than twice as long as its greatest thickness. Posterior pronotal margin feebly angulate. Median line of propodeum distinctly impressed. Fore wing with the marginal cell nearly twice its own length from the wing-tip; third submarginal cell petiolate.

Abdomen with a brush of hair on the fourth sternite, as described above. Sternite 6 with a slit-like emargination. Subgenital plate (Fig. 128) unusually slender, on the apical half parallel-sided, the apex obtusely angulate; disc and apex clothed with moderately long setae. Genitalia (Fig. 155) with the parameres slightly expanded apically, strongly setose; digitus shaped much as in the preceding two species, the upper, outer margin with a number of long setae, somewhat sinuate at the tip, the apex of the digitus with some shorter, diverging setae; aedoeagus gradually expanded to near the apex, which is obliquely truncate on each side.

Distribution.—This species is known from a very few localities in Louisiana and eastern Texas.

Specimens seen: 5 ♂ ♂. Texas: Lee Co., 3 ♂ ♂, May, June (Birkmann) [MCZ]; Williamson Co., 1 ♂, 28 May 1935 (J. E. Gillaspy) [JEG]; Louisiana: Madison Co., 1 ♂, Tallulah, 25 June 1948 (R. C. Gaines) [USNM].

5. **Anoplius (Pompilinus) krombeini** Evans

(Pl. XIV, fig. 90; pl. XIX, fig. 127; pl. XXII, fig. 156.)

Anoplius (*Pompilinus*) n. sp. Krombein, 1950, Jour. Elisha Mitchell Sci. Soc., 65: 264.

Anoplius (*Pompilinus*) *krombeini* Evans, 1950, Jour. Kansas Ent. Soc., 23: 88-89. [Type: ♂; Kill Devil Hills, N. C., 28 May 1948 (K. V. Krombein); U.S.N.M. no. 59,476.]

The male of this species possesses a brush of hair on the fourth sternite, a character which allies it with the preceding four species. However, the genitalia are more of the type characteristic of the *cylindricus*-group, with which this species may be considered annectant. In both sexes the front is rather narrow; in the female the propodeum is somewhat longer and less steeply declivous than in related species.

FEMALE.—Length 8 (6-10) mm. Color black; wings lightly infuscated, somewhat darker along the outer margin. Pubescence wholly brownish-fuscous. Front and vertex with a few weak setae; front coxae setose, the other coxae, the pronotum, mesonotum, and scutellum sometimes slightly hairy; propodeum without erect hairs.

Clypeus 2.5 times as broad as high, its apical margin slightly arcuately concave. Front rather narrow, the middle interocular distance varying from .53 to .56 times the transfacial distance. Inner orbits slightly converging above, the upper interocular distance about .9 times the lower. Vertex not at all elevated above the eye-tops; ocelli in about a right triangle, the postocellar line equal to or slightly greater than the ocello-ocular. First four antennal segments in a ratio of about 9:3:12:11, the third antennal segment equal to about .85 times the upper interocular distance. (Head shown in Fig. 155.)

Pronotum with the slope rather low and even, the posterior margin distinctly angulate. Propodeum relatively long, the declivity ill-defined and not steep; median line vaguely impressed. Spines of the tarsal comb about as long as the thickness of the tarsus; basitarsus with 3 comb-spines. Fore wing with the marginal cell somewhat less than twice its own length from the wing-tip; second submarginal cell usually a little broader than high; third submarginal petiolate.

MALE.—Length 6.7 (6-7.5) mm. Color black; wings nearly hyaline, with a brownish outer marginal band. Pubescence brownish, more or less silvery on the clypeus, lower front, temples, coxae, pronotum, pleura, and propodeum. Clypeus, front, and vertex with a very few short setae; abdominal sternite 4 with a brush of suberect setae of moderate length (longer than in *percitus* or *subcylindricus*); sternite 5 and the subgenital plate with shorter, suberect setae.

Clypeus a little over twice as broad as high, its apical margin slightly arcuately concave. Front rather narrow; inner orbits diverging very slightly above. Ocelli as in the female. Antennae very slender, the first four segments in a ratio of about 3 : 1 : 3 : 3, the third segment about 3 times as long as thick. Posterior pronotal margin angulate. Propodeum with a weakly impressed median line, its slope very low, only slightly steepened behind. Venation as in female.

Abdominal venter with a short brush of hairs as described above. Sternite 6 with a rather deep U-shaped emargination. Subgenital plate with the median line strongly elevated, the median ridge and apex clothed with short, suberect setulae; the side-pieces are unpigmented and clothed with very small setae (Fig. 127). Genitalia (Fig. 90) with the parameres broadened apically, subclavate, clothed ventrally and along the outer margin with sparse, long setae. Volsellae with a group of small setae on the basis, one of which is a little longer than the others; digiti gradually expanded to the apex, which is rounded on the outer side, acute at the inner angle; digiti clothed with fairly long setae which are angled at their apices, and on the upper, outer portion with a number of much longer, sinuate setae. Aedoeagus slender, the apex with two somewhat truncate lobes, between which it is deeply cleft.

Distribution.—This species inhabits the Austroriparian fauna, from Florida north along the Atlantic coast to New Jersey.

Specimens seen: 48 (25 ♀♀, 23 ♂♂). NEW JERSEY: Atlantic Co., 1 ♂, Weymouth, 27 June [CU]; Burlington Co., 1 ♀, Brown's Mills, 3 Sept. [USNM]; NORTH CAROLINA: Dare Co., 20 ♀♀, 16 ♂♂, Kill Devil Hills, 25 May-3 June [KVK, USNM, HEE]; FLORIDA: 1 ♀ (no further data) [ANSP]; 1 ♂, Suwannee Springs, 3 July [UK]; Clay Co., 1 ♂, Hibernia, 7 Aug. [UK]; Collier Co., 1 ♀, 10-40 mi. E. of Everglade, 30 Aug. [CU]; Hendry Co., 2 ♀♀, 1 ♂, La Belle, 8 Apr.-10 May [CU]; Lee Co., 1 ♂, Sanibel Isl., 13 May [CU]; Orange Co., 1 ♂, Orlando, 4 Apr. [JEG]; Polk Co., 1 ♂, Lakeland, 10 Nov. [AMNH].

Cylindricus Species-group

This group includes twelve closely related species in which the male venter is smooth or practically so, without short brushes of hair on any of the sternites. The male genitalia are all of a similar pattern; the parameres are distinctly broader apically than near the base (except sometimes in *estellina* Banks). In this group a careful examination of the male genitalia and subgenital plate is essential for identification. The characters which separate the females are for the most part exceedingly subtle. The females of three species have not been distinguished, though they doubtless occur in collections and are being confused with other species at the present time.

6. **Anoplius (Pompilinus) cylindricus** (Cresson)
(Pl. XIV, fig. 91; pl. XIX, fig. 123.)

Pompilus cylindricus Cresson, 1867, Trans. Amer. Ent. Soc., 1:92. [Lectotype: ♂; Texas (no further data); A.N.S.P. no. 553.]—Cresson, 1872, Trans. Amer. Ent. Soc., 4: 203.—Dalla Torre, 1897, Cat. Hymen., VIII, p. 284.—[?]Birkmann, 1899, Ent. News, 10: 244.

Pompilinus cylindricus Ashmead, 1902, Canad. Ent., 34: 85, 86. [Selected genotype of n. gen. *Pompilinus*.]

[?] *Anoplius cylindricus* Viereck, 1906, Trans. Amer. Ent. Soc., 32: 223.

[?] *Pompiloides cylindricus* Banks, 1914, Jour. N. Y. Ent. Soc., 22: 301.—[?] Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.

Arachnophila brevihirta Banks, 1945, Psyche, 52: 105. [Type: ♀; Chicago, Ill., July (C. T. Brues); M.C.Z. no. 26,739.] New synonymy.

Pompilinus truncatus Dreisbach, 1949, Ent. Amer., (n. s.) 29: 15-16, 32, 48, figs. 40 and 41. [Type: ♂; Gratiot Co., Mich., 2 Aug. 1947 (R. R. Dreisbach); M.C.Z.]. New synonymy.

Pompilinus subtruncatus Dreisbach, 1949, Ent. Amer., (n. s.) 29: 17-18, 33, 54, figs. 58 and 59. [Type: ♂; Lincoln, Nebr., 14 June 1909 (C. H. Gable); Univ. Nebraska (not seen by present author).] New synonymy.

Pompilinus hispidus Dreisbach, 1949, Ent. Amer., (n.s.) 29: 23-24, 32, 50, figs. 47 and 48. [Type: ♂; Tuscola Co., Mich., 20 Aug. 1940 (R. R. Dreisbach); M.C.Z.]. New synonymy.

Anoplius (*Pompilinus*) *cylindricus* Krombein, 1950, Jour. Elisha Mitchell Sci. Soc., 65: 264. [Dare Co., N. C.]

No American pompilid has been so consistently misidentified as *cylindricus*.[12] Indeed, it has been customary to call almost any male of this subgenus (and some males of other subgenera and genera) "*cylindricus*." Cresson's type series was a mixture of species. However, in selecting a lectotype, Cresson chose a specimen from Texas having a slender, acute, hirsute subgenital plate. I have not examined the genitalia of the type, but feel certain that the true *cylindricus* is the species here discussed under that name, as the subgenital plate is very distinctive.

This is probably the commonest member of the subgenus in the prairie regions of central North America. I have collected both sexes in series in several localities, and have little doubt that the association of the sexes expressed here is correct. The variation in color, size, pilosity, and certain morphological features in this species is very striking, and quite disconcerting in a subgenus so homogeneous as this. Nevertheless, after a careful study of nearly two hundred specimens, from a wide variety of localities, I have been unable to find any constant characters which will enable one to divide the species in any way. The broad front and short, convex, somewhat hairy propodeum of the female are distinctive, as are the acute, hirsute subgenital plate and truncate digiti of the male.

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[12] This has recently been pointed out vehemently by Dreisbach (1949, p. 27). Yet this author not only misidentified the species, but redescribed it under three different names within ten pages!

FEMALE.—Length 8 (4.5-12) mm. Color black, the abdomen marked with orange or yellow-brown over the greater part of the first two tergites, occasionally over part of the third tergite, sometimes over part of the basal sternites. Fore wings lightly to moderately infuscated, somewhat darker along the margin; hind wings subhyaline, darker apically. Pubescence brownish, except pale where the integument is colored, and sometimes silvery on the base of the mandibles and a small part of the clypeus and lower front. Clypeus, front, and vertex with numerous short, dark, erect hairs; thorax with a variable but often considerable amount of short, erect hair; propodeum with at least a small amount of short hair on the sides, sometimes conspicuously hairy.

Clypeus about 2.5 times as broad as high, its apical margin truncate. Front very broad, the middle interocular distance varying from .60 to .65 times the transfacial distance. Inner orbits slightly convergent above, the upper interocular distance from .8 to .9 times the lower interocular. Ocelli rather small and far apart, forming an angle in front which is usually greater than a right angle; postocellar line subequal to or somewhat greater than ocello-ocular line. Antennae relatively short, the first four segments in a ratio of about 30:10:35:32 (somewhat variable in this respect, but segment 3 always shorter than 1 plus 2), segment 3 equal to from .5 to .7 times the upper interocular distance.

Pronotum rather long, its posterior margin broadly angulate or subangulate. Propodeum short and convex, with a fairly well defined, nearly flat posterior declivity. Mesosternum usually slightly produced in the form of two small processes over the inner bases of the middle coxae, with a V-shaped emargination between. Tarsal comb with the spines a little more stout than is usual in the subgenus, varying from 1 to 2 times as long as the thickness of the tarsus; basitarsus with either 3 or 4 comb-spines. Fore wing with the marginal cell about 1.5 times its own length from the wing-tip; third submarginal cell triangular, often petiolate.

MALE.—Length 8 (3.5-12) mm. Color black, the second abdominal tergite occasionally marked with orange. Wings subhyaline, the outer margin of the fore wing with a fuscous band. Pubescence conspicuously silvery at least on the front, sides of the clypeus, and the propodeum, often over the greater part of the head and thorax. Front and vertex a little hairy, also the pronotum, front coxae, and sometimes the sides of the propodeum very slightly; body otherwise without erect hairs, except that the subgenital plate is somewhat hirsute, and there may be some scattered, inconspicuous small hairs on the abdominal sternites.

Clypeus about twice as broad as high, or slightly broader. Middle interocular distance varying from .58 to .64 times the transfacial; upper interocular distance subequal to or slightly greater than the lower. Ocelli rather large and prominent, forming an angle in front which may be greater or less than a right angle. First four antennal segments in a ratio of about 5:2:5:5; in some specimens segment 3 is a little shorter than 4 and only a little more than twice as long as thick; in others it is slightly longer than 4 and nearly 3 times as long as thick. Pronotum rather long, angulate or subangulate behind. Propodeum sloping but slightly in front, much more steeply on the posterior fourth, its median line weakly if at all impressed. Venation like that of the female and in no way distinctive.

Abdomen slender, cylindrical; sternite 6 with a narrowly U-shaped emargination. Subgenital plate (Fig. 123) with the median line slightly to strongly raised, the disc slightly to strongly hirsute; sides of the plate converging behind to an acute or subacute tip. Genitalia (Fig. 91) with the parameres strong, basally slender and with very prominently raised squamae, apically expanded, the tip more or less acute; outer margin setose, the inner ventral border also with a row of setae; dorsal side setose along the upper, outer margin, the setae forming a row which runs basad just inside the inner margin. Volsellae with only some minute hairs on the basis; digiti large and prominent, gradually expanded from the base, the apex abruptly truncate, the inner apical angle acute, the outer angle rounded; disc of the digitus clothed with short setae of variable density, the upper, outer angles with a number of longer setae. Parapenials unusually slender, strongly curved apically; aedoeagus of moderate breadth, slightly broadened apically.

Biology.—This species is most characteristic of inland, well-drained areas, especially sand dunes or semidesert areas. Males come frequently to flowers, and have been taken on *Solidago, Asclepias, Cleome, Sphaeralcea, Conium,* and *Melilotus,* and also at honeydew. Females rarely visit flowers, but I have taken a few on *Melilotus alba.* The species appears to have several generations a year, occurring from May to September in the latitude of Minnesota, February to October in Texas. Its nesting habits are as yet unknown.

Distribution.—This species is very widely distributed, occurring from Florida, Texas, and Arizona to Connecticut, New York, Ontario, Northwest Territories, and central Oregon. It is, however, most abundant in the Great Plains, northern Mississippi Valley, and Great Lakes regions, and elsewhere apparently uncommon.

Specimens seen: 185 (116 ♀♀, 69 ♂♂). The following records are marginal or from areas where the distribution may be discontinuous: CONNECTICUT: Hartford Co., 7 ♀♀, 7 ♂♂, 13 June-17 Sept. [HEE]; NEW YORK: Oswego Co., 3 ♀♀, 2 July [USNM]; ONTARIO: 1 ♀, Ridgeway, 24 July [MCZ]; MICHIGAN: Chippewa Co., 1 ♀, Whitefish Point, 30 June [MCZ]; MANITOBA: 2 ♀♀, 2 ♂♂, Aweme, July-Sept. [CNC]; NORTHWEST TERRITORIES: 1 ♂, Fort Norman, 6 Aug. [CNC]; ALBERTA: 1 ♂, Ironsprings, 16 June [CNC]; MONTANA: 3 ♂♂ (no further data) [ANSP]; OREGON: Lake Co., 1 ♂, Summer Lake, 26 Aug. [OSC]; UTAH: Emery Co., 1 ♀, 16 July [Minn.]; ARIZONA: Navajo Co., 1 ♀, Kayenta, 15 July [CAS]; NEW MEXICO: Dona Ana Co., 1 ♀, Mesilla Park, 4 Aug. [USNM]; TEXAS: Jeff Davis Co., 18 ♂♂, 6-10 mi. W. of Ft. Davis, 15-23 July [HEE, ANSP]; Hidalgo Co., 1 ♀, Mercedes, Feb. [USNM]; FLORIDA: Citrus Co., 2 ♀♀, Red Level, 6 July [UK]; Orange Co., 1 ♀, Winter Park, 2 May [Mass.]; NORTH CAROLINA: Dare Co., 12 ♀♀, 1 ♂, Kill Devil Hills, 26 May-5 June [KVK].

7. **Anoplius (Pompilinus) californiae** Evans

(Pl. XIV, fig. 92; pl. XIX, fig. 129.)

Anoplius (*Pompilinus*) *californiae* Evans, 1948, Pan-Pac. Ent., 24: 128-129, and figs. 1, 2, & 7, p. 127. [Type: ♀; La Paz, Baja Calif., Mexico, 3 June 1921 (E. P. VanDuzee); C.A.S. no. 5949.]

Pompilinus californiae Dreisbach, 1949, Ent. Amer., (n.s.) 29: 28, 31, 54, pl. XI, figs. 55 & 56.

The female of this species shows much resemblance to the preceding, especially in the facial configuration, the strong tarsal comb, and the hairiness of the propodeum; it is, however, wholly black, and the antennae are somewhat longer. The genitalia of the male are very distinctive, particularly the aedoeagus.

FEMALE.—Length 10.5 (8.5-12.5) mm. Color black; fore wings moderately infuscated, slightly darker along the margin, often somewhat violaceous; hind wings subhyaline, darker apically. Pubescence fuscous, on the abdomen often reflecting deep metallic colors; base of the mandibles often with a patch of silvery pubescence. Body with erect hairs as follows: clypeus, front, and vertex in moderate abundance; front coxae with strong hairs in front and finer hairs behind; remainder of thorax, and the propodeum, with a variable but usually considerable amount of short erect hair, including the middle and hind coxae and usually to some extent the front femora.

Head distinctly broader than high; vertex straight across between the tops of the eyes. Clypeus from 2.5 to 2.8 times as broad as high, its apical margin truncate. Front rather broad, the middle interocular distance from .56 to .62 times the transfacial distance. Inner orbits subparallel below, slightly convergent above, the upper interocular distance from .83 to .93 times the lower interocular. Ocelli rather far apart, forming an angle in front which is a right angle or somewhat greater; postocellar line slightly greater than ocello-ocular. Antennae elongate, the first four segments in a ratio of about 15:5:24:20, segment 3 equal to from .65 to .8 times the upper interocular distance.

Pronotum of moderate length, its slope even, its posterior margin broadly angulate. Propodeum short, convex, posteriorly with a rather well-defined declivity. Mesosternum with small angulate processes which overlie the inner bases of the middle coxae, and between which is a V-shaped emargination. Front tarsus with a well-developed comb, the spines longer than the width of the tarsus, often nearly twice as long; basitarsus with either 3 or 4 comb-spines, the one at the apex equal to from .4 to .9 times the second tarsal segment. Fore wing with the second submarginal cell somewhat broader than high, the third submarginal petiolate.

Male.—Length 8 (6.5-9.5) mm. Color black; wings hyaline to moderately infuscated, with a darker marginal band. Pubescence largely fuscous or fusco-violaceous, conspicuously silvery at least on the lower front, clypeus, and temples, sometimes over the whole front, pronotum, coxae, propodeum, and parts of the pleurites. Clypeus, front, vertex, temples, and propleura with abundant short, dark hairs; thorax and propodeum with a variable but usually considerable amount of erect hair (for this subgenus), occasionally scarcely hairy.

Clypeus a little over twice as broad as high, its apical margin truncate. Front rather broad, the middle interocular distance about .6 the transfacial; upper interocular distance subequal to or a little greater than the lower interocular. Ocelli large and prominent, forming a right angle or somewhat greater in front. First four antennal segments in a ratio of about 5:2:5:5, segment 3 from 2 to 2.8 times as long as thick. Posterior pronotal margin broadly angulate. Propodeum short and full, its median line lightly if at all impressed.

Abdomen subfusiform, a little stout for the subgenus. Sternite 6 with a U-shaped apical emargination. Subgenital plate (Fig. 129) rather broad, obtusely pointed apically, its median line slightly raised, the plate clothed with small setae, which are usually grouped to form a small tuft on each side near the base. Genitalia (Fig. 92) with the parameres strong, expanded apically, the outer margin strongly setose, the squamae somewhat prominent and provided with a group of short hairs. Volsella with a group of hairs on the basis, 1 or 2 of which are rather long; digitus long and rather narrow, strap-shaped, clothed with setae of moderate length, the upper, outer angles with several somewhat longer setae. Aedoeagus of rather variable shape, not always as broad as in the specimen figured, sometimes nearly parallel-sided basally, but always rather broadly expanded just below the apex.

Biology.—This species is restricted to the arid regions of the deep Southwest. It has been taken on salt cedar (*Tamarix gallica* L.) and sunflower (*Helianthus annuus* L.). Collection dates vary from April to October.

Distribution.—This is a Lower Sonoran species, ranging from Lower California north to southern New Mexico, Arizona, and central California.

Specimens seen: 21 (13 ♀♀, 8 ♂♂). NEW MEXICO: Otero Co., 1 ♀, 12 mi. SW of Alamogordo, 27 July [HEE]; ARIZONA: 1 ♀ (no further data) [USNM]; Pima Co., 1 ♂, Tucson, 17 Oct. [CU]; Pinal Co., 1 ♀, Florence, May [ANSP]; CALIFORNIA: Fresno Co., 1 ♂, Coalinga, 14 May [CIS]; Inyo Co., 1 ♀, Owens Lake, 2 June [CU]; Kings Co., 1 ♂, Kettleman City, 23 April [CAS]; Merced Co., 1 ♂, Los Banos, 23 May [CAS]; San Bernardino Co., 5 ♀♀, Boyer Ranch, 29 Palms [MCZ]; San Diego Co., 1 ♀, 23 June [CAS]; San Joaquin Co., 2 ♂♂, Tracy, 7 June & 1 Aug. [CIS]; BAJA CALIFORNIA: 1 ♀, Angeles Bay, 7 May [USNM]; 1 ♀, 2 ♂♂, La Paz, 3-5 June [CAS]; 1 ♀, Magdalena Bay, 30 May [CAS].

8. **Anoplius (Pompilinus) estellina** (Banks) new combination (Pl. XIV, fig. 93; pl. XIX, fig. 130.)

Pompiloides estellina Banks, 1914, Jour. N. Y. Ent. Soc., 22: 303. [Type: ♂; Fosters, San Diego Co., Calif., 29 May (E. P. VanDuzee); M.C.Z. no. 13,673.]—Banks, 1919, Bull. Mus. Comp. Zool., 63: 236.

Psammochares (Pompiloides) estellina Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.

Pompilinus estellina Dreisbach, 1949, Ent. Amer., (n.s.) 29: 32, 40, pl. IV, fig. 20, pl. V, fig. 24.

The type of this species is an aberrant specimen, having the claws of the middle and hind tarsi toothed instead of bifid. The female associated with *estellina* by Banks in his original description belongs to *Pompilus phoenix* Evans. True *estellina* is a member in good standing in the subgenus *Pompilinus,* closely allied to *californiae.* The female may be recognized by its small size, very broad front, and by having the vertex slightly arcuately raised above the tops of the eyes; this sex closely resembles *subcylindricus,* with which its range in part overlaps, but there is a small amount of hair on the sides of the propodeum and the pronotum is angulate behind. The male is best recognized by the extremely broad subgenital plate and the unusual shape of the aedoeagus, which is abruptly broadened ("hammer-headed") apically.

FEMALE.—Length 7.5 (7-8) mm. Color black; fore wings moderately infuscated, somewhat darker apically; hind wings subhyaline, darker apically. Pubescence fuscous, obscurely violaceous. Front and vertex with short dark hairs; temples and propleura with dense, fine hair; pronotum, mesonotum, scutellum, sides of the propodeum, coxae, and sometimes the front femora, with scattered short hairs.

Clypeus 2.8 times as broad as high, its anterior margin truncate or slightly concave. Front very broad, the middle interocular distance from .61 to .65 times the transfacial distance. Inner orbits slightly emarginate in the middle, somewhat convergent above, the upper interocular distance from .85 to .95 times the lower. Ocelli in a right triangle, the laterals about equidistant from the eyes and from each other. Antennae rather short, the first four segments in a ratio of about 25:10:32:28, segment 3 varying from .56 to .64 times the upper interocular distance. Temples rather wide, in lateral aspect over half the width of the eye; vertex raised slightly, arcuately above the tops of the eyes, seen in anterior aspect.

Pronotum short, its posterior margin distinctly angulate. Propodeum short and convex, the median line impressed in front, posteriorly with a well-defined flattened declivity. Front tarsus with a comb of very short spines, not longer than the width of the tarsus; basitarsus with 3 comb-spines. Fore wing with the 2d submarginal cell about as broad as high, the 3d submarginal usually long-petiolate; cells rather far removed from the wing margin.

MALE.—Length 6.5 (5.5-8) mm. Color black; wings hyaline or nearly so, the outer margin of the fore wing and apex of the hind wing broadly infuscated. Pubescence silvery at least on the lower front, clypeus, and propodeum, often over the greater part of the head and thorax, elsewhere brownish-cinereous, sometimes slightly violaceous. Front and vertex with numerous short, dark hairs; temples and propleura rather hairy; front coxae and pronotum a little hairy; remainder of body practically without erect hair.

Clypeus about 2.3 times as broad as high, truncate below. Middle interocular distance from .62 to .66 times the transfacial distance, and about 1.2 times the lower interocular distance; upper interocular distance subequal to or slightly greater than lower. First 4 antennal segments in a ratio of about 25:10:22:24, segment 3 only about twice as long as its greatest thickness. Pronotum short, its posterior margin angulate. Propodeum with the median line impressed, the slope much steepened behind. Venation in no way distinctive; third submarginal cell always petiolate; marginal cell often as much as twice its own length from the wing-tip.

Abdomen slightly less long and slender than is usual in the subgenus. Sternite 6 with a narrow, U-shaped emargination. Subgenital plate (Fig. 130) broad, its median line slightly elevated, the apex obtusely pointed, the sides broadly expanded, unpigmented but clothed with small setae. Genitalia (Fig. 93) with the parameres slender, slightly curved, the outer margin and dorsal surface somewhat setose, the ventral surface with only minute setae over most of its surface; in some specimens the parameres are slightly expanded apically, as in the figure, but in others they are slender throughout. Volsella with a small group of setae on the basis, one of which is very long, half the length of the digitus, and a second which is about half the length of this. Digitus long and rather slender, its apex acute, the disc clothed with short setae, those on the upper, outer protion a bit longer. Parapenials straight, distinctly expanded apically. Aedoeagus slender, apically with an abrupt truncated expansion on each side, giving it a "hammer-headed" appearance.

Distribution.—This apparently rare species occurs in the Upper Sonoran and Transition faunas, from New Mexico and California to Alberta.

Specimens seen: 10 (3 ♀♀, 7 ♂♂). CALIFORNIA: Alameda Co., 1 ♀, Alameda, 12 May [CAS]; Inyo Co., 1 ♂, Olancha, 20 May [CIS]; San Diego Co., 1 ♂, Fosters, 29 May [MCZ]; NEW MEXICO: Guadalupe Co., 1 ♀, Santa Rosa, 23 June [UK]; Lincoln Co., 1 ♂, Alto, 24 June [CU]; UTAH: Salt Lake Co., 1 ♂, 8 June [MCZ]; 1 ♀, 2 ♂♂, Saltair, 21 May & 12 July [CAS]; ALBERTA: 1 ♂, Lethbridge, 2 July [CNC].

9. **Anoplius (Pompilinus) tenebrosus** (Cresson)

(Pl. XIV, fig. 94; pl. XX, fig. 135.)

Pompilus tenebrosus Cresson, 1865, Proc. Ent. Soc. Phila., 4: 453. [Type: ♀; Colorado (no further data); A.N.S.P. no. 417.]—Cresson, 1867, Trans. Amer. Ent. Soc., 1: 89. [Colo., Me.]—[?] Cresson, 1872, Trans. Amer. Ent. Soc., 4: 203. [Texas.]—Provancher, 1882, Nat. Canad., 13: 35, 39.—Provancher, 1883, Nat. Canad., 14: 35.—Dalla Torre, 1897, Cat. Hymen., VIII, p. 326.—[?] Birkman, 1899, Ent. News, 10: 244. [Texas.]

Pompilus compactus Provancher, 1895, Nat. Canad., 22: 111. [Type: ♀; Vancouver, B. C.; Q.P.M., white label no. 301.] New synonymy.

Anoplius tenebrosus Smith, 1910, Ann. Rpt. N. J. State Mus. 1909, p. 674. [N. J., several localities.]

Pycnopompilus tenebrosus Woodworth, 1913, Guide to Calif. Ins., p. 100. [Calif.]

Psammochares (Psammochares) tenebrosus Rohwer, 1916, Conn. Geol. Nat. Hist. Survey Bull. 22, pp. 633, 634. [Conn.]

Psammochares (Anoplius) tenebrosus Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 987. [N. Y., many localities.]—Johnson, 1930, List Ins. Fauna Nantucket, p. 111.—[?] Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 127, 128. [N. C., several localities.]—[?] Brimley, 1938, Insects No. Carolina, p. 434.

Pompiloides canadensis Banks, 1919, Canad. Ent., 51: 82. [Type: ♂; Truro, Nova Scotia, 12 Aug. 1913 (R. Matheson); C. U. no. 680.] —Procter, 1938, Biol. Survey Mt. Desert Reg., VI, Insecta, p. 430.

Anoplius compactus Banks, 1919, Bull. Mus. Comp. Zool., 63: 235.

Anopliella tenebrosa Banks, 1939, Canad. Ent., 71: 227. [Selected genotype of n. gen. *Anopliella.*]—Procter, 1946, Biol. Survey Mt. Desert Reg., VII, Insecta, p. 491.

Psammochares (Pompilinus) canadensis Procter, 1946, Biol. Survey Mt. Desert Reg., VII, Insecta, p. 491.

Pompilinus tenebrosus Strickland, 1947, Canad. Ent., 79: 125. [Alta., several localities.]—Dreisbach, 1949, Ent. Amer., (n.s.) 29: 27-28, 31, 52, pl. X, figs. 49, 50.—Dreisbach, 1950, Amer. Midl. Nat., 42: 722-723.

This is a common wasp across the continent in the Canadian and Transition Zones. Fortunately it is rather easily separated from related species. Males may be readily recognized by the unusual subgenital plate (Fig. 135) which is completely flat, and bears two weak carinae on its disc. Females may be told by the hairiness of the body, especially the propodeum, the short tarsal comb, and the wholly black integument overlaid with a fusco-violaceous pubescence.

FEMALE.—Length 11 (7.5-15) mm. Color black; fore wings lightly to rather heavily infuscated, often somewhat violaceous; hind wings subhyaline, the outer margin infuscated. Pubescence brownish or nearly black, generally with a violaceous tinge, especially on the abdomen; base of the mandibles often with a patch of silvery pubescence. Front and vertex with numerous erect hairs; pro- and mesonota, scutellum, propodeum, and coxae all with noticeable dark, erect hair; mesopleura and front femora often a bit hairy.

Clypeus about 2.5 times as broad as high, truncate below. Front of moderate breadth, the middle interocular distance varying from .55 to .61 times the transfacial distance. Inner orbits slightly emarginate near the middle, slightly convergent above, the upper interocular distance from .78 to .88 times the lower. Ocelli forming a right or obtuse angle in front, the postocellar line equal to or greater than the ocello-ocular. Antennae fairly long, the first 4 segments in a ratio of about 9:3:12:10, segment 3 from .6 to .9 times the upper interocular distance, averaging about .75.

Posterior margin of pronotum varying from arcuate to angulate, most commonly with a broad, rather indistinct angulation. Propodeum with the median line vaguely if at all impressed, posteriorly with a not-strongly-defined flattened declivity. Front tarsus with a comb of spines not or scarcely longer than the width of the tarsus; basitarsus with 3 comb-spines. Fore wing with the marginal cell from 1.3 to 1.8 times its own length from the wing-tip; third submarginal cell triangular, nearly always petiolate.

MALE.—Length 9 (6.5-12) mm. Color black; wings hyaline or subhyaline, the outer margins with a broad fuscous band. Pubescence silvery on the scape below, clypeus, front, temples, coxae, mesopleura, front and sides of the pronotum, sides of the scutellum, metanotum, propodeum except for the sides, and to some extent the front legs; elsewhere the pubescence is fusco-violaceous. Front and vertex with a number of short erect hairs; front coxae and pronotum slightly hairy; sometimes the mesonotum, scutellum, and propodeum very slightly hairy; abdomen scarcely or not at all hairy.

Clypeus about twice as broad as high, truncate below. Front of moderate breadth, the middle interocular distance about .6 the transfacial distance. Upper and lower interocular distances subequal, or either slightly the greater. Ocelli in about a right triangle. First 4 antennal segments in a ratio of about 25:10:27:25, segment 3 about 2.8 times as long as thick. Posterior pronotal margin subangulate. Propodeum rather abruptly declivous behind, its median line usually lightly impressed.

Abdomen slender, cylindrical. Sternite 6 with the emargination narrowly U-shaped. Subgenital plate (Fig. 135) of moderate breadth, flat, with two rather weak carinae on the disc, which converge slightly caudad; apex of the plate evenly rounded. Genitalia (Fig. 94) characterized chiefly by the digiti, which are evenly rounded apically, the disc clothed with setae of moderate length, some of which are clubbed. The parameres are stout and rather heavily pigmented, with convexly raised squamae. Basis volsellaris with only some minute hairs; hooklets slender; aedoeagus slender, a little wider apically, the apex subtruncate and deeply cleft medially.

Gynandromorph.—A specimen from Jemez Springs, N. M. [CU] is wholly female except the head, which is entirely male.

Biology.—This species occurs in sandy places, particularly in the vicinity of woods; the nest is a short tunnel in the earth with an enlarged terminal cell. A specimen from Rancocas Park, N. J. [USNM], is pinned with the spider *Schizocosa saltatrix* Hentz (Lycosidae); another from Pullman, Wash. [Minn.], is pinned with *Xysticus gulosus* Keys. (Thomisidae) [det. B. J. Kaston]. The species is often attracted to goldenrod, *Solidago* spp., and has also been taken on *Angelica, Cleome,* and *Eryngium.*

Distribution.—This species occurs transcontinentally from the upper extremities of the Upper Austral Zone far into the Hudsonian.

Specimens seen: 676 (388 ♀♀, 287 ♂♂, 1 gynandromorph). The following records appear to be marginal: NOVA SCOTIA: 1 ♀, Cape Bretton Isl., June [MCZ]; NEWFOUNDLAND: 2 ♀♀; Harmon Field, 27-30 May [CNC]; LABRADOR: 4 ♀♀, 1 ♂, Goose Bay, 10 June-2 Aug. [CNC]; NORTHWEST TERRITORIES: 1 ♀, 17 ♂♂, Norman Wells, 24-28 June [CNC]; 1 ♀, Reindeer Depot, McKenzie Delta, 11 July [CNC]; YUKON: 12 ♀♀, Watson Lake, 20-25 June [CNC]; BRITISH COLUMBIA: 2 ♀♀, Vancouver [CNC, QPM]; CALIFORNIA: Riverside Co., 1 ♀, Keen Camp, San Jacinto Mts., May [CIS]; Tulare Co., 2 ♀♀, Sequoia Nat. Park, 6-7000 feet, July [CU]; NEVADA: Lander Co., 1 ♂, Austin, 12 Aug. [UK]; UTAH: Beaver Co., 1 ♀, Beaver Creek, June [OSC]; NEW MEXICO: Sandoval Co., 3 ♀♀, 1 gynandromorph, Jemez Springs, 7500 feet, Apr.-July [CU]; COLORADO: Teller Co., 3 ♀♀, Florissant, June [USNM, MCZ]; Larimer Co., 1 ♀, Fort Collins, 15 May [USNM]; SOUTH DAKOTA: Custer Co., 21 ♀♀, 3 ♂♂, 2 mi. S. of Custer, 24 Aug. [HEE]; MINNESOTA: Hennepin Co., 1 ♂, Ft. Snelling, July [Minn.]; WISCONSIN: Clark Co., 1 ♂, Worden Township, July [AMNH]; MICHIGAN: Saginaw Co., 1 ♀, June [Coll. R. L. Fischer]; ONTARIO: 1 ♀, Komoka, June [CNC]; PENNSYLVANIA: Centre Co., 2 ♀♀, State College, May [PSC]; VIRGINIA: Fairfax Co., 1 ♂, Falls Church, June [MCZ]; NEW JERSEY: Cumberland Co., 2 ♀♀, Menantico, May [CU].

10. **Anoplius (Pompilinus) insolens** (Banks) new combination

(Pl. XIV, fig. 95; pl. XX, fig. 136; pl. XXII, fig. 157.)

Pompiloides insolens Banks, 1912, Jour. N. Y. Ent. Soc., 19: 226. [Type: ♂; Black Mt., N. C., May; M.C.Z. no. 13,681.]—Procter, 1938, Biol. Survey Mt. Desert Reg., VI, Insecta, p. 430. [S. W. Harbor, Me.]

Pompiloides cylindricus Rohwer, 1916, Conn. Geol. Nat. Hist. Survey Bull. 22, pp. 631, 632. [*Nec* Cresson; misidentification.]—[?] Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 124, 125.—[?] Brimley, 1938, Insects No. Carolina, p. 433.

Psammochares (Pompiloides) insolens Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 124, 125. [N. C., several localities.]—Brimley, 1938, Insects No. Carolina, p. 433. —Procter, 1946, Biol. Survey Mt. Desert Reg., VII, Insecta, p. 491.

Pompilinus insolens Strickland, 1947, Canad. Ent., 79: 124. [Medicine Hat, Alta.]—Dreisbach, 1949, Ent. Amer., (n.s.) 29: 28, 33, 50, pl. IX, fig. 43, 44.

This species is more widely distributed than has usually been realized, occurring from coast to coast, chiefly south of the range of *tenebrosus,* to which it is closely related. The female has only a small amount of very short, fine hair on the sides of the propodeum; this sex is very similar to the following species, *clystera,* the only character for separating them known to me being the somewhat broader front of *insolens.* The male *insolens* is rather easily told by the characteristics of the terminalia: the subgenital plate is obtusely pointed, the median line not distinctly elevated, but the disc a little convex in cross-section; the parameres of the genitalia are also quite unlike those of any other species (Fig. 95).

FEMALE.—Length 10.5 (7.5-14) mm. Color black; fore wings moderately infuscated, a little darker along the outer margin, often somewhat violaceous; hind wings subhyaline, darker apically. Pubescence wholly deep brownish-violaceous. Front and vertex with scattered erect hairs; pronotum and front coxae a little hairy, and to a lesser extent the mesonotum, scutellum, mesopleura, and middle and hind coxae; propodeum usually with some very short, fine hair on the sides of the slope.

Clypeus about 2.5 times as broad as high, its apical margin truncate or very slightly concave. Front rather broad, the middle interocular distance varying from .56 to .60 times the transfacial distance, averaging .58. Inner orbits subparallel below, convergent above, the upper interocular distance varying from .78 to .92 times the lower. Ocelli in about a right triangle, rather small and far apart, the postocellar line often slightly greater than the ocello-ocular. First four antennal segments in a ratio of about 6:2:8:7, segment 3 equal to from .68 to .84 times the upper interocular distance. Vertex, in anterior view, raised very slightly if at all above the tops of the eyes; temples, in lateral view, generally about half the width of the eye.

Posterior margin of the pronotum angulate, sometimes rather indistinctly so. Propodeum with a fairly well-defined posterior declivity. Spines of the tarsal comb short, not or but little longer than the width of the tarsus; basitarsus with 3 comb-spines. Wing venation like that of the preceding species and not in any way distinctive.

MALE.—Length 9 (6.5-11) mm. Color black; wings hyaline or nearly so, with a fuscous outer marginal band; occasionally the wings are almost wholly fuscous. Pubescence fusco-violaceous, sometimes wholly so, but usually silvery over a considerable part of the head, thorax, and propodeum. Front and vertex with a few weak hairs; prothorax slightly hairy; remainder of body without noticeable erect hairs.

Clypeus about twice as broad as high, its apical margin truncate. Front moderately broad, the inner orbits subparallel, slightly emarginate near the middle. Ocelli in about a right triangle, the postocellar line equal to or a little greater than the ocello-ocular. Antennae slender, the first 4 segments in a ratio of about 3:1:3:3, segment 3 from 2.5 to 3 times as long as thick. Posterior pronotal margin angulate to nearly arcuate. Propodeum rather long, the median line somewhat impressed.

Abdomen smooth, slender, and cylindrical. Sternite 6 with a narrowly U-shaped emargination. Subgenital plate (Fig. 136) of moderate breadth, its apex obtusely angular, the disc slightly convexly raised, but the median line itself not prominent; disc and outer margin clothed with only small setae. Genitalia (Fig. 95) with the parameres gradually expanded nearly to the apex, which is subtruncate; outer margin and apex with setae of moderate length, the inner margin ventrally on the apical half with a single series of setae. Basis volsellaris with a number of very short and one very long setae; digitus much as in *clystera*, rather slender, slightly curved, and with an acute apex; the disc is clothed with small setae, most of which are clubbed; on the upper outer margin are several (6 to 14) long setae which are somewhat sinuate apically. Parameres slender, a little thickened toward the apex; aedoeagus slender, slightly expanded apically, the tip obliquely truncate on each side.

Biology.—This species occurs principally in or around sandy areas, and doubtless nests in the sand. I have taken a single female with the spider *Maevia vittata* (Hentz) ♀ (Salticidae) [det. B. J. Kaston], which it was dragging over the ground in a sandy area at East Hartford, Conn. *Insolens* is commonly taken on flowers, and has been captured on *Pastinaca sativa, Daucus carota, Asclepias, Sphaeralcea angustifolia, Petalostemon oligophyllum, Achillea millefolium, Chrysanthemum leucanthemum, Cleome lutea, Eriogonum,* and *Chrysothamnus.*

Distribution.—This species occurs transcontinentally from the Lower Austral to the Transition Zones.

Specimens seen: 345 (242 ♀♀, 103 ♂♂). The following records are marginal: MAINE: Lincoln Co., 1 ♂, 11 Aug. [CIS]; MASSACHUSETTS: Franklin Co., 1 ♀, Warwick, 27 July [CM]; NEW YORK: Essex Co., 1 ♂, New Russia, 18 Aug. [CU]; Tompkins Co., 24 ♂♂, Ithaca, 19 June-4 Aug. [HEE, CU]; ONTARIO: 1 ♂, Toronto, 29 July [CNC]; MICHIGAN: Cheboygan Co., 1 ♂, 27 June [Coll. R. L. Fischer]; MINNESOTA: Kittson Co., 1 ♀, Lancaster, 26 Aug. [Minn.]; MANITOBA: 1 ♀, Aweme, 4 Sept. [CNC]; 1 ♂, Treesbank, 18 Aug. [CNC]; ALBERTA: 3 ♀♀, 2 ♂♂, Medicine Hat, July-Aug. [CNC]; 1 ♀, Kipp, 9 Sept. [CNC]; BRITISH COLUMBIA: 2 ♀♀, Creston, 10 Sept. [CNC]; 1 ♂, Victoria, 25 June [CNC]; CALIFORNIA: San Diego Co., 1 ♀, Coronado Beach, Apr. [CAS]; ARIZONA: Santa Cruz Co., 1 ♂, Nogales, 30 Aug. [CU]; MEXICO: Chihuahua, 1 ♀, 16 mi. SE of Chihuahua, 11 July [AMNH]; TEXAS: Presidio Co., 2 ♀♀, 2 ♂♂, Marfa, 18-27 July [HEE]; Lee Co., 1 ♀, 1 ♂, Fedor, Apr. [MCZ]; ARKANSAS: Logan Co., 1 ♀, Mt. Magazine, 10 June [HEE]; KENTUCKY: Edmonson Co., 1 ♂, 8 June [HEE]; GEORGIA: Macon Co., 1 ♂, Oglethorpe, 31 July [CU].

11. **Anoplius (Pompilinus) clystera** (Banks) new combination
(Pl. XV, fig. 96; pl. XIX, fig. 134.)

Pompiloides clystera Banks, 1914, Jour. N. Y. Ent. Soc., 22: 302. [Type: ♂; Stanford Univ., Calif.; M.C.Z. no. 13,675.]—Banks, 1919, Bull. Mus. Comp. Zool., 63: 235, 236.

Psammochares (*Pompiloides*) *clystera* Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.

Pompilinus clystera Dreisbach, 1949, Ent. Amer., (n. s.) 29: 27, 38, 42, pl. III, fig. 14, pl. V, fig. 22.

The female *clystera* is very similar to *insolens,* differing principally by the narrower front. The male is clearly distinguishable from several other species only by the genitalia: the parameres are slightly curved, not wider just below the apex than about halfway out, the apex itself acute; the digiti are closely set with hairs of moderate length which are angled near their apices, except on the outer margin near the apex, where there are a number of long, straight setae (Fig. 96). The median line of the subgenital plate is strongly elevated; this is helpful in identifying California specimens, but further east a number of other species also possess this character.

Female.—Length 10 (7-13) mm. Color black; fore wings moderately to heavily infuscated, usually darker along the outer margin, often violaceous; hind wings subhyaline to moderately infuscated. Pubescence fusco-violaceous, a little paler on the coxae, on the abdomen often bluish-refulgent. Erect hairs of the same abundance and distribution as in the preceding species.

Clypeus about 2.5 times as broad as high, its apical margin truncate or a little concave. Front narrow, the middle interocular distance varying from .53 to .56 (the average about .55) times the transfacial distance. Inner orbits converging slightly above, the upper interocular distance from .8 to .95 times the lower. Ocelli in about a right triangle, the postocellar line slightly greater than the ocello-ocular. Antennae elongate, the first four segments in a ratio of about 6:2:8:7, segment 3 equal to from .70 to .90 times the upper interocular distance. Vertex, in anterior view, scarcely elevated above the eye-tops.

Posterior margin of pronotum broadly angulate or subangulate. Propodeum of moderate length, its median line impressed in front, posteriorly with a rather distinct flattened, oblique declivity. Spines of the tarsal comb about as long as the width of the tarsus; basitarsus with 3 comb-spines. Wing venation in no way distinctive; second submarginal cell usually but not always broader than high; third submarginal cell nearly always petiolate.

MALE.—Length 8.5 (6-11) mm. Color black; wings varying from hyaline with a fuscous outer marginal band to almost wholly fuscous, violaceous. Pubescence varying from wholly fusco-violaceous, reflecting bluish (California specimens especially), to mostly silvery (Texas and Colorado specimens especially). Clypeus, front, vertex, temples, and prothorax with a few hairs, the body otherwise without noticeable erect hairs.

Clypeus 2 to 2.3 times as broad as high, its apical margin truncate. Front of variable breadth, the middle interocular distance from .58 to .64 times the transfacial distance. Upper interocular distance subequal to or slightly greater than the lower. Ocelli prominent, in about a right triangle, the post-ocellar line greater than the ocello-ocular as 5 is to 4. First four antennal segments in a ratio of about 5:2:5:5, segment 3 about 2.5 times as long as its greatest thickness. Posterior pronotal margin varying from subarcuate to angulate. Propodeum with the median line slightly impressed or not; slope very low in front, suddenly precipitous behind.

Abdomen slender, smooth, cylindrical. Sternite 6 with a narrow, slit-like emargination posteriorly. Subgenital plate (Fig. 134) of moderate breadth, the sides arcuately approaching to the apex, which is somewhat pointed; median line strongly elevated; sides of the plate mostly unpigmented, but covered with small setae. Genitalia (Fig. 96) with the parameres large, slightly curved, the squamae prominent; parameres broadened gradually to about the middle, then about the same width nearly to the apex, which tapers to a subacute point; the outer margin is strongly setose, and the ventral surface more or less covered with small setae, including some along the inner margin. Base of the volsella with a group of small setae; digitus gradually broadened to near the apex, where the outer margin is abruptly arched, the inner forming an angulation; disc of the digitus clothed rather heavily with short hairs which are angled at their apices, on the outer margin with several long, straight hairs. Parapenials slender, slightly curved apically; aedoeagus slender, with an apical expansion which is obliquely truncate on each side.

Biology.—This species has been taken on *Eriogonum, Solidago, Cleome serrulata, Bifora americana, Asclepias, Solanum, Verbesina, Tamarix, Conium maculatum,* and *Chaerophyllum teinturieri.* Dates of capture cover the period from April to October.

Distribution.—This is an Austral species inhabiting the western United States, ranging from southern California and eastern Texas to Kansas, Colorado, and north-central California.

Specimens seen: 113 (70 ♀♀, 43 ♂♂). The following localities appear to be marginal: TEXAS: Kleburg Co., 1 ♂, Riviera Beach, 18 June [HEE]; Dallas Co., 2 ♀♀, Apr., Oct. [USNM, Minn.]; KANSAS: Reno Co., 4 ♀♀, Arkansas River, 18 June [HEE, KSC]; Riley Co., 1 ♂, Manhattan, 25 June [HEE]; COLORADO: Larimer Co., 4 ♀♀, Poudre Canyon, 5200 feet, 26 July [HEE]; CALIFORNIA: San Francisco, 2 ♀♀, Lone Mt., 1-4 July [CAS]; San Diego Co., 2 ♀♀ [CAS]; Riverside Co., 1 ♀, 1 ♂, Blythe, 23 June [CIS]; ARIZONA: Santa Cruz Co., 1 ♂, Ruby, 27 July [UK]; NEW MEXICO: Otero Co., 1 ♂, Alamogordo, 26 June [UK]; TEXAS: Presidio Co., 2 ♂♂, Presidio, May [USNM].

12a. **Anoplius (Pompilinus) rectangularis rectangularis** (Dreisbach) new combination (Pl. XV, fig. 100; pl. XIX, fig. 131.)

Pompilinus rectangularis Dreisbach, 1949, Ent. Amer., (n. s.) 29: 18-20, 33, 46, figs. 34 and 35. [Type: ♂; Falls Church, Va., 11 July (N. Banks); M.C.Z.]

This is the first of two species, known from males only, in which the subgenital plate is very broad, the median line elevated, the apex acute, and the broad side-pieces unpigmented and wholly devoid of even minute setulae; in both species the parameres are gradually broadened nearly to the apex, then suddenly narrowed, and the digiti are attenuate apically and for the most part lacking the long setae on the upper, outer margin characteristic of most species of this subgenus. This form is best recognized by the prominent setae along the inner margin of the parameres ventrally.

FEMALE.—Unknown, or at least not separable at present from certain other species of this subgenus.

MALE.—Length 7.5 (5.5-9.5) mm. Color black; wings subhyaline, the outer margin of the fore wing and apex of the hind wing with a broad brownish band. Pubescence very fine, over most of the head, thorax, and propodeum more or less silvery. Front, vertex, and anterior coxae with a few dark hairs, the body otherwise devoid of erect hairs.

Clypeus about 2.2 times as broad as high, its apical margin truncate. Front of moderate breadth, the middle interocular distance varying from .58 to .63 times the transfacial. Inner orbits subparallel or diverging slightly above. Ocelli forming a right or acute angle in front, the postocellar line equal to or slightly greater than the ocello-ocular line. Antennae very slender, the first four segments in a ratio of about 3:1:3:3, or segment 3 relatively slightly longer, this segment more than 3 times as long as its maximum thickness. Pronotum of moderate length, the posterior margin angulate, sometimes rather indistinctly so. Propodeum with the median line impressed, the surface nearly flat in front, obliquely declivous on its posterior fourth. Third submarginal cell of the fore wing petiolate.

Abdomen slender, cylindrical; sternite 6 with the emargination narrow, slit-like. Subgenital plate (Fig. 131) broad, the sides rounded to the apex, which is slightly, acutely produced; median line distinctly elevated, pigmented, and somewhat setose, but the broad side-pieces hyaline and devoid of even minute setulae. Genitalia (Fig. 100) with the parameres gradually broadened nearly to the apex, then obliquely subtruncate, longer along the inner than the outer margin; squamae not prominent; ventral surface more or less setose, including a series of rather long setae near the inner margin. Basis volsellaris with a group of small setae; digitus gradually widened to a point about two-thirds of the way out, thereafter attenuate, the apex acute; ventral surface of the digitus clothed with short setae which are angled at their apices, these setae gradually shorter in length toward the apex. Parapenials slender, slightly curved; aedoeagus rather slender, expanded apically, the expansions obliquely truncate on each side.

Biology.—This species occurs in sandy places, where it may be found flying rapidly and erratically over the sand, in association with such species as *A.* (*P.*) *marginatus, A.* (*P.*) *subcylindricus,* and *Evagetes parvus.* It is not known to visit flowers, but has been taken on honeydew.

Distribution.—This form is widely distributed in the Upper Austral and Transition zones, from Massachusetts, Ontario, Michigan, and Minnesota to Colorado, Kansas, Ohio, and North Carolina.

Specimens seen: 36 ♂♂. The following records appear to be marginal: MASSACHUSETTS: Suffolk Co., 1 ♂, Boston, Aug. [CAS]; VERMONT: Windsor Co., 1 ♂, Woodstock [MCZ]; NEW YORK: Tompkins Co., 16 ♂♂, Ithaca, 14 June-10 Aug. [HEE, CU, ANSP, USNM]; ONTARIO: 1 ♂, Toronto, 1 Aug. [CNC]; MICHIGAN: Otsego Co. (recorded by Dreisbach, 1949); MINNESOTA: Chisago Co., 1 ♂, 16 July [Minn.]; IOWA: Woodbury Co., 1 ♂, Sioux City, 26 June [USNM]; COLORADO: Yuma Co., 1 ♂, Wray, 17-19 Aug. [AMNH]; KANSAS: Atchison Co. (recorded by Dreisbach, 1949); OHIO: Franklin Co., 2 ♂♂, 3 July [RWS]; NORTH CAROLINA: Buncombe Co., 1 ♂, Black Mt., 25 Aug. [AMNH]; VIRGINIA: Fairfax Co., 1 ♂, Falls Church, 11 July [MCZ].

12b. **Anoplius (Pompilinus) rectangularis gillaspyi** new subspecies (Pl. XV, fig. 101.)

Anoplius (*Pompilinus*) *splendens* Krombein, 1950, Jour. Elisha Mitchell Sci. Soc., 65: 264. [Based on specimens misidentified by H. E. Evans.]

This form is extremely similar to typical *rectangularis,* but exhibits minor (though constant) genitalic differences and occurs south of the range of that form.

FEMALE.—Unknown.

MALE (Holotype).—Length 7 mm.; fore wing 5 mm. Color black; wings subhyaline, darker apically; head and thorax extensively silvery-sericeous.

Postocellar line: ocello-ocular line about as 4:3. Angulation of posterior pronotal margin broad but distinct. Abdomen cylindrical; subgenital plate as described and figured under the nominate subspecies.

Genitalia (Fig. 101) with the parameres curved slightly, rather long, but not surpassing the other appendages as much as in *rectangularis rectangularis*; apex of parameres more or less truncate, the parameres about as long along the outer margin as the inner. Digiti slender, elongate, clothed with setae which become shorter apically; apex obliquely truncate, the tip subacute, but less attenuate than in the typical subspecies.

Fifteen male paratypes vary in length from 6.5 to 9.5 mm. and compare very closely with the type.

Distribution.—Austroriparian fauna, from eastern Texas to coastal North Carolina.

Holotype.—TEXAS: Bastrop Co., ♂, 27 April 1935 (J. E. Gillaspy) [ANSP].

Paratypes.—TEXAS: Lee Co., 1 ♂, Fedor, 7 July 1946 (H. E. Evans) [HEE]; NORTH CAROLINA: Dare Co., 14 ♂ ♂, Kill Devil Hills, in woods, 28 May-16 July 1948-50 (K. V. Krombein) [KVK, USNM].

13a. **Anoplius (Pompilinus) stenotus stenotus** (Banks) new combination (Pl. XV, fig. 98; pl. XIX, fig. 132.)

Pompiloides stenotus Banks, 1914, Jour. N. Y. Ent. Soc., 22: 302. [Type: ♂; Bradentown, Fla., March (VanDuzee); M.C.Z. no. 13,674.]

Psammochares (Pompiloides) stenotus Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.

Pompilinus stenotus Dreisbach, 1949, Ent. Amer., (n. s.) 29: 33, 50, pl. IX, figs. 45 and 46.

This species is clearly distinguishable from the preceding only on genitalic characters. The parameres are devoid of setae over most of the ventral surface, and lack the strong setae along the inner margin characteristic of *rectangularis;* the digiti are similar in shape but the upper outer margin is more arcuate.

FEMALE.—Unknown.

MALE.—Length 7 (6.5-8) mm. Color black; wings subhyaline or lightly infuscated, the outer margins with a broad fuscous band. Pubescence conspicuously silvery over the greater part of the head, thorax, coxae, and propodeum. Front and vertex with scattered dark hairs; temples and propleura with pale hair; front coxae and pronotum very slightly hairy; body otherwise practically devoid of erect hairs.

Clypeus about twice as broad as high, truncate below. Front of moderate breadth, the middle interocular distance varying from .56 to .63 times the transfacial distance. Upper interocular distance subequal to or a little greater than the lower. Ocelli prominent, in about a right triangle, the postocellar line equal to or a little greater than the ocello-ocular. Antennae slender, the first four segments in a ratio of about 14:5:14:14, segment 3 nearly three times as long as its greatest thickness. Posterior pronotal margin angulate or subangulate. Median line of propodeum lightly impressed. Third submarginal cell of the fore wing petiolate.

Abdomen smooth and slender, the 6th sternite with a slitlike posterior emargination. Subgenital plate (Fig. 132) broad, the median line somewhat elevated, pigmented, and setose (more so than in *rectangularis*), the sides hyaline and without even minute setulae. Genitalia (Fig. 98) with the parameres straight, gradually broadened to the apex, which is obliquely truncate, the inner margin of the paramere exceeding the outer; ventral surface devoid of setae except for those along the outer margin and apex, and a few along the inner margin just above the squamae. Basis volsellaris with only some minute setae. Digiti elongate, spindle-shaped, clothed with setae which are angled at their apices, except for a few straight ones at the upper, outer margin. Parapenials slender, slightly curved; aedoeagus slightly expanded apically, the expansion obliquely truncate on each side.

Distribution.—This form is known only from a few localities in Florida and southern Alabama.

Specimens seen: 8 ♂♂. FLORIDA: Dade Co., 1 ♂, Biscayne Bay (Mrs. Slosson) [AMNH]; Manatee Co., 2 ♂♂, Bradentown, March (VanDuzee) [MCZ]; Dry Tortugas, 1 ♂, Loggerhead Key, Aug. 1936 (H. H. Plough) [CU]; ALABAMA: Clarke Co., 2 ♂♂, Thomasville, 11 June 1917 [MCZ]; Washington Co., 2 ♂♂, Leroy, 11 June 1917 [MCZ].

13b. **Anoplius (Pompilinus) stenotus bequaerti** (Dreisbach) new combination (Pl. XV, fig. 99.)

Pompilinus bequaerti Dreisbach, 1949, Ent. Amer., (n. s.) 29: 16-17, 33, 44, 48, pl. VI, fig. 32, pl. VIII, fig. 42. [Type: ♂; Meredosia, Ill., 11-19 Nov. 1913, sand pit; Ill. Nat. Hist. Survey (not seen by present author).]

This is a more widely distributed form than *stenotus stenotus,* from which it differs slightly in the shape of the parameres and in having a short but easily observed carina near the apex of the volsellar digitus. I am inclined to consider these differences of only subspecific value at present, although a final decision on such a matter can scarcely be made from so little material of only one sex.

FEMALE.—Unknown.

MALE.—Length 7 (5-10) mm. Color black; pubescence silvery over the greater part of the head, thorax, and propodeum. Body devoid of erect hairs except for a few inconspicuous ones on the front, vertex, pronotum, and front coxae. Wings nearly hyaline, the outer margins with a broad band of fuscous.

Morphological features as described under the nominate subspecies, except for the following differences in the genitalia. The parameres tend to be a little longer along the outer margin than the inner, and the apex is usually somewhat rounded; the ventral surface is without setae except for a very few on the inner margin just above the squamae. Digiti spindle-shaped, clothed with setae which are angled at their apices, except on the apical one-half to one-third, where they are reduced; on the outer side just below the apex is a small carina which parallels the margin for a short distance. The straight setae which are present on the upper, outer margin of the digitus of *stenotus stenotus* are mostly absent in this subspecies. (Fig. 99.)

Biology.—This form occurs, like many of its congeners, in sand pits and dunes. It has been taken also on the flowers of *Solidago, Baccharis,* and *Bifora.*

Distribution.—Austroriparian and Carolinian faunas, from Texas and Florida to Alberta, Minnesota, Michigan, and North Carolina. There are no records from east of the Appalachians north of the Carolinas.

Specimens seen: 20 ♂♂. TEXAS: Brazos Co., 4 ♂♂, Apr., Oct. [JEG, MCZ, USNM]; Williamson Co., 1 ♂, 5 Oct. [JEG]; KANSAS: Riley Co., 1 ♂, Manhattan, 4 June [HEE]; ALBERTA: 1 ♂, Medicine Hat, 17 July [CNC]; MINNESOTA: Anoka Co., 7 ♂♂, Fridley San Dunes, 3 June-3 Aug. [Minn., HEE]; Hennepin Co., 1 ♂, 6 June [CU]; ILLINOIS: Mason Co., 1 ♂, Devil's Hole, Havana, 18 Aug. [AMNH]; MICHIGAN: Huron Co. (recorded by Dreisbach, 1949); NORTH CAROLINA: Moore Co., 1 ♂, So. Pines, 26 June [MCZ]; FLORIDA: Hillsboro Co., 1 ♂, 8 Feb. [USNM]; Palm Beach Co., 2 ♂♂, Lake Worth [AMNH].

14. **Anoplius (Pompilinus) townesi** new species (Pl. XVI, fig. 102.)

Pompilinus reductus Dreisbach, 1949, Ent. Amer., (n. s.) 29: 25-27, 33, 44, pl. VI, figs. 28 and 29. [*Nec* Banks, 1914.]

This form was associated tentatively with Banks' *reductus* by Dreisbach (1949). I consider the latter a synonym of *marginatus* Say, and must therefore provide a name for the males considered here. It is likely that the female of *townesi* is marked with red and is at present being confused with what is here called *marginatus,* but there seems to be no reason at present for associating it specifically with *reductus.* The answer to this and to similar dilemmas in this subgenus will be found, I suspect, not by further ponderings over long processions of pinned specimens, but by field observations directed toward accurately associating the sexes and defining the distinctive behavior-patterns of the various species.

FEMALE.—Unknown.

MALE (Holotype).—Length 7.5 mm.; fore wing 5.5 mm. Color black, the basal two-thirds of the second abdominal tergite dorsally brownish-orange. Wings subhyaline, the veins brownish, the outer margin with a brownish band. Pubescence very fine, silvery on the clypeus, lower front, temples, pronotum, coxae, mesopleura, and propodeum, elsewhere brownish-cinereous. Front, vertex, temples, propleura, pronotum, and front coxae with a very few dark hairs, the body otherwise without noticeable erect hairs.

Clypeus twice as broad as high, its apical margin truncate. Middle interocular distance .61 times the transfacial; upper interocular distance 1.05 times the lower. Ocelli forming a right angle in front; postocellar and ocello-ocular lines about equal. First four antennal segments in a ratio of about 14:6:16:15, segment 3 about 3 times as long as thick. Pronotum broadly angulate behind. Median line of propodeum very lightly impressed. Fore wing with the second submarginal cell about as broad as high; third submarginal cell petiolate.

Abdomen smooth, slender, cylindrical. Emargination of sternite 6 narrowly U-shaped. Subgenital plate with the median line elevated rather strongly, the entire plate clothed with setulae (very similar to that of *clystera,* shown in Fig. 134). Genitalia (Fig. 102) with the parameres gradually expanded to a point about two-thirds the way out, then of about the same width nearly to the apex, where they are obliquely truncate, longer along the inner margin than the outer; ventral surface of parameres wholly covered with small setae. Volsellar basis with a group of very minute setae; digitus elongate, somewhat fusiform, the disc clothed with short hairs which are angled at their apices, the upper, outer margin with several long, straight setae. Parapenials slender, slightly curved; aedoeagus slender, slightly expanded apically.

Thirty-four male paratypes vary in length from 6.5 to 9 mm. In only one of the paratypes are there red markings on the second abdominal tergite as in the type, all the others being entirely black. In some specimens the third antennal segment is not perceptibly longer than the first or fourth; the middle interocular distance varies from .58 to .64 times the transfacial distance; the upper and lower interocular distances are in most cases about equal.

Biology.—I have taken this species on the flowers of *Daucus carota* and *Pastinaca sativa* (Umbelliferae). It occurs in woodlands as well as open places and does not seem to be as strictly psammophilous as many of its congeners.

Distribution.—This species is chiefly characteristic of the Alleghanian fauna of the eastern United States, ranging from New Hampshire, Quebec, Ontario, Michigan, and Manitoba south in the Appalachians to Georgia.

Holotype.—NEW YORK: Chautauqua Co., ♂, Bemus Point, 15 July 1937, on wild parsnip flowers at dusk (H. K. Townes) [ANSP].

Paratypes.—NEW YORK: Essex Co., 1 ♂, Keene Valley, 16 July [AMNH]; Tompkins Co., 1 ♂, Enfield Glen, 29 July [HEE]; 5 ♂ ♂, Ithaca, May-July [CU, HEE]; CONNECTICUT: Middlesex Co., 1 ♂, East Haddam, 25 Aug. [HEE]; MASSACHUSETTS: Middlesex Co., 1 ♂, Melrose Highlands, 28 June [CAS]; Suffolk Co., 1 ♂, Boston, 30 Aug. [CAS]; NEW HAMPSHIRE: Cheshire Co., 2 ♂ ♂, Nelson, 15 Aug. [USNM]; Rockingham Co., 1 ♂, Hampton [USNM]; VERMONT: Rutland Co., 1 ♂, 15 Aug. [MCZ]; QUEBEC: 1 ♂, Aylmer, 17 July [CNC]; 1 ♂, Hemmingford, 24 June [CNC]; 2 ♂ ♂, Kazabazua, 8 July, 4 Aug. [CNC]; 1 ♂, Knowlton, 24 July [CNC]; 5 ♂ ♂, Val Morin, 20-30 July [CU]; ONTARIO: 2 ♂ ♂, Ottawa, 26 June, 31 July [CNC]; 1 ♂, Toronto, 15 July [CNC]; MANITOBA: 1 ♂, Aweme, 3 July [CNC]; MINNESOTA: Ramsey Co., 1 ♂ [Minn.]; PENNSYLVANIA: Philadelphia, 2 ♂ ♂ [CU]; DISTRICT OF COLUMBIA: 1 ♂, Washington, 6 Sept. [MSV]; GEORGIA: Fulton Co., 1 ♂, Pine Park, 17 March [HEE]. No locality data: 1 ♂ [CU].

Dreisbach (1949, p. 26) gives a considerable number of Michigan records for this species (under the name *reductus*).

15. **Anoplius (Pompilinus) marginatus** (Say)

(Pl. XV, fig. 97; pl. XXI, figs. 151, 153; pl. XXII, figs. 161, 165.)

Pompilus marginatus Say, 1824, Narr. Exp. St. Peter's River, II, p. 333. [Type: ♀; "Northwest Territory and Missouri"; (no longer extant).] —F. Smith, 1855, Cat. Hymen. Brit. Mus., III, p. 160.—Cresson, 1865, Proc. Ent. Soc. Phila., 4: 454. [Colo.]—Cresson, 1867, Trans. Amer. Ent. Soc. 1: 98. [Many localities.]—Cresson, 1868, Trans. Amer. Ent.

Soc., 1: 378. [N. Mex.]—Cresson, 1872, Trans. Amer. Ent. Soc., 4: 203. [Texas.]—Provancher, 1882, Nat. Canad., 13: 35, 40. [Que.] ——Dalla Torre, 1897, Cat. Hymen., VIII, p. 300.—Peckham and Peckham, 1898, Wisc. Geol. Nat. Hist. Survey, Bull. 2, pp. 144-152. [Biology.]—Hancock, 1899, Ent. News, 10: 29. [Biology.]—Hartman, 1905, Bull. Univ. Texas, no. 65, pp. 52-54. [Biology.]

Pompilus petiolatus Say, 1835, Boston Jour. Nat. Hist., 1: 305. [Type: ♀; "Indiana"; (no longer extant).] [*Nec* Van der Linden, 1827.]—F. Smith, 1855, Cat. Hymen. Brit. Mus., III, p. 160.—Cresson, 1867, Trans. Amer. Ent. Soc., 1: 98. [Placed in synonymy with *marginatus*.]

[?] *Pompilus cylindricus* Provancher, 1882, Nat. Canad., 13: 35, 39.

Entypus marginatus Howard, 1901, The Insect Book, pl. XI, fig. 14.

[not] *Anoplius* (*Pompilinus*) *marginatus* Viereck, 1902, Proc. Acad. Nat. Sci. Phila., 54: 735. [San Pedro, Calif.]

[?] *Anoplius* (*Entypus*) *marginatus* Viereck, 1906, Trans. Amer. Ent. Soc., 32: 223, 232, 239. [Ariz., N. Mex., Texas.]

Anoplius marginatus J. Smith, 1910, Ann. Rpt. N. J. State Mus. 1909, p. 674.

[?] *Anoplius cylindricus* J. Smith, 1910, Ann. Rpt. N. J. State Mus. 1909, p. 674.

Pompiloides marginatus Banks, 1912, Ent. News, 23: 108. [Va.]—Rohwer, 1916, Conn. Geol. Nat. Hist. Survey Bull. 22, pp. 631, 632. [Conn.]—Rau and Rau, 1918, Wasp Studies Afield, pp. 58-63. [Biology.]—Robertson, 1928, Trans. Acad. Sci. St. Louis, 25: 307, 308, 317. [Fla.]—Procter, 1938, Biol. Survey Mt. Desert Reg., VI, Insecta, p. 430. [Me.]

Pompiloides reducta Banks, 1914, Jour. N. Y. Ent. Soc., 22: 302. [Type: ♀; Falls Church, Va., 23 June (N. Banks); M.C.Z. no. 13,670.] New synonymy.

Psammochares (*Pompiloides*) *marginatus* Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 987.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 124, 125. [N. C.]—Brimley, 1938, Insects No. Carolina, p. 433.

Psammochares (*Pompiloides*) *reducta* Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 987.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 124, 126.—Brimley, 1938, Insects No. Carolina, p. 433.

Pompiloides hageni Banks, 1919, Bull. Mus. Comp. Zool., 63: 235. [Type: ♀; Weeksville, Mont., 2 Aug. 1882; M.C.Z. no. 10,400.] New synonymy.

[?] *Psammochares* (*Pompiloides*) *cylindricus* Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 987.

Pompilinus marginatus Strickland, 1947, Canad. Ent., 79: 125. [Medicine Hat, Alta.]—Dreisbach, 1949, Ent. Amer., (n. s.) 29: 29-30, 48, pl. VIII, figs. 38 and 39.

Anoplius (*Pompilinus*) *marginatus* Evans, 1948, Ent. News, 59: 183-184. [Biology.]—Krombein, 1950, Jour. Elisha Mitchell Sci. Soc., 65: 264. [Kill Devil Hills, N. C.]

As the long list of references suggests, *marginatus* is one of the commonest pompilids over much of North America east of the Rockies. However, since a number of other species have in the past been confused with *marginatus*, it is not possible to assert definitely that all the above references actually pertain to this species. Indeed, it is possible that the females of more than one species are still being confused under this name. The male is fortunately not only distinct genitalically, but possesses an excellent external character which separates it at once from all its congeners: along the inside of the hind basitarsus for its entire length is a series of short erect hairs (Fig. 165).

FEMALE.—Length 10 (5.5-13) mm. Color black, the abdomen marked with orange-brown over most of the second tergite and frequently over most of the first tergite, rarely over the base of the third tergite and part of the basal sternites. Wings lightly to rather heavily infuscated, with a darker marginal band. Pubescence brownish, rarely a bit silvery on the lower front and clypeus. Front and vertex with a few erect hairs; front coxae slightly hairy, pro- and mesonota and scutellum often a bit so; propodeum without erect hairs.

Clypeus about 2.5 times as broad as high, truncate below. Front of moderate breadth, the middle interocular distance varying from .53 to .59 times the transfacial distance. Inner orbits converging somewhat above, the upper interocular distance from .78 to .88 times the lower. Ocellar triangle varying from acute to obtuse, the postocellar line often slightly greater than the ocello-ocular. Antennae of rather variable length, the first four segments in a ratio of about 7:2:9:8, segment three sometimes slightly longer than 1 plus 2, equal to from .7 to 1.0 times the upper interocular distance; outer antennal segments somewhat variable in length, sometimes as long as in *splendens*, sometimes as short as in *cylindricus*.

Pronotum with the anterior slope low and even, the posterior margin broadly angulate. Propodeum rather short (Fig. 161), the dorsum strongly arched, in full dorsal view about 1.3 times as broad as long; declivity rather large, oblique, fairly well defined. Spines of the tarsal comb not or scarcely longer than the thickness of the tarsus; basitarsus with 3 comb-spines. Fore wing with the marginal cell about 1.5 times its own length from the wing-tip; third submarginal cell usually petiolate (Fig. 153).

MALE.—Length 7.5 (4.5-10) mm. Color black, the second abdominal tergite occasionally and the adjacent tergites and sternites infrequently marked with orange. (Specimens from the southern parts of the range tend to be more extensively marked with orange than those from the North.) Wings nearly hyaline, the outer margins with a light brownish band. Pubescence silvery over the greater part of the head, thorax, and propodeum. Front, vertex, pronotum, and front coxae a bit hairy; temples and propleura with some fine hair; body otherwise devoid of erect hair.

Clypeus from 2 to 2.2 times as broad as high. Middle interocular distance varying from .55 to .64 times the transfacial distance. Inner orbits nearly parallel; ocelli in approximately a right triangle, the postocellar line equal to or a little greater than the ocello-ocular. First four antennal segments in a ratio of about 5:2:5:5, segment 3 between 2.5 and 3 times as long as its greatest thickness. Posterior pronotal margin angulate, sometimes not distinctly so. Propodeum strongly declivous on its posterior fourth (Fig. 151), its median line feebly if at all impressed. Hind basitarsus with short erect hairs along the inner side for its entire length (Fig. 165). Venation like that of related species and in no way distinctive.

Abdomen slender and smooth; sternite 6 with a U-shaped emargination. Subgenital plate rather broad, the median line distinctly elevated, the sides broadly rounded and the apex subacute; disc entirely clothed with small setae except basally. Genitalia (Fig. 97) with the parameres of approximately the same width throughout most of their length, the ventral surface clothed with small setae, the outer margin with a series of rather long setae. Basis volsellaris with a group of minute setae; digitus subspatulate, the extreme apex somewhat pointed, the disc clothed sparsely with setae which are angled at their apices, the upper, outer margin with several long setae which are also angled at their apices. Parapenials slender, curved but slightly; aedoeagus expanded only slightly apically.

Gyandromorph.—A gynandromorph collected by the author in a sand-pit at Ithaca, N. Y., is 6.5 mm. long and wholly black. The head is completely female in its characters; the prothorax is essentially female, the front tarsus possessing a tarsal comb, the last tarsal segment having a row of spines beneath, and the pulvillar comb of this tarsus being well developed. The pronotum, however, is silvery-sericeous and more of the shape of the male. The remainder of the thorax is male; the middle and hind legs are weakly spinose, the apical tarsal segments are without spines beneath, and the pulvillar comb of these legs is weakly developed. The propodeum and abdomen are also wholly male, and the genitalia entirely normal in appearance.

Biology.—This species is probably most characteristic of small sand pits, gardens, and open, sandy woodlands, although it occurs in a wide variety of habitats. The prey consists of spiders belonging to at least seven different families and exhibiting many different modes of life, and the species is even known to take phalangids occasionally (Evans, 1948). The prey is dragged over the ground by the wasp walking backward; occasionally it will fly backward for a few feet with its prey (Peckham and Peckham, 1898). The Raus (1918) observed it carrying its prey with ease up an overhanging earthen bank. The wasp has the habit of hiding its prey under foliage or clods of earth while the nest is being constructed. For further description of its habits, the reader is referred to the vivid accounts by the Peckhams (1898) and the Raus (1918), as well as to shorter accounts by Hancock (1899), Hartman (1905), and Evans (1948).

The male *marginatus* does not appear to visit flowers, but is usually found flying erratically close to the ground in sandy areas. The female, however, is a frequent visitor to flowers, and has been taken on *Daucus carota, Pastinaca sativa, Conium maculatum, Ceanothus americanus, Spiraea latifolia, Cleome serrulata, Melilotus alba, Solidago, Eupatorium,* and *Polytaenia.* The flight period is from June to September in the northern parts of the range, from March to November in the South.

Distribution.—Temperate North America east of the Rockies, from Florida, Texas, and Arizona to Nova Scotia, Quebec, Ontario, Northwest Territories, and Alberta (with a single record from British Columbia). In the northeastern United States it is probably the commonest species of Pompilidae, though farther west and south it is less abundant.

Specimens seen: 1078 (856 ♀♀, 221 ♂♂, 1 gynandromorph). The following records are from the margins of the range: NOVA SCOTIA: 1 ♀, Digby, 21 Aug. [CU]; PRINCE EDWARD ISLAND: 3 ♀♀, 3 ♂♂, Canad. Nat. Park, July-Aug. [CNC]; QUEBEC: 1 ♀, 1 ♂, Kazabazua, 9 Aug. [CNC]; ONTARIO: 1 ♀, Bobcaygeon, 9 July [CNC]; MICHIGAN: Emmett Co., 1 ♀, July [MCZ]; MINNESOTA: Clearwater Co., 5 ♀♀, July-Aug. [Minn.]; MANITOBA: 7 ♀♀, Aweme, June-Sept. [CNC]; SASKATCHEWAN: 1 ♂, Codette, 5 July [CNC]; NORTHWEST TERRITORIES: 1 ♀, Fort Norman, 15 Aug. [CNC]; ALBERTA: 1 ♀, Tilley, 25 Aug. [Alta.]; BRITISH COLUMBIA: 1 ♀, Buccaneer Bay, 20 July [CNC]; MONTANA: 3 ♀♀, 12 ♂♂ (no further data) [ANSP]; UTAH: Utah Co., 1 ♀, Provo Canyon, 15 Sept. [Minn.]; ARIZONA: Coconino Co., 1 ♀, Flagstaff, 21 Aug. [CAS]; NEW MEXICO: Otero Co., 1 ♀, Sixteen Springs Canyon, Sacramento Mts., 26 July [HEE]; TEXAS: Webb Co., 1 ♀, Laredo, 24 Sept. [JEG]; Montgomery Co., 1 ♀, 1 ♂, Willis, 14 Apr., 11 June [USNM]; LOUISIANA: Cameron Co., 1 ♀, 17 June [UK]; ALABAMA: Mobile Co., 3 ♀♀, 18-19 Oct. [CAS]; FLORIDA: Lee Co., 1 ♀, Punta Rassa, 12 May [CU].

16. **Anoplius (Pompilinus) splendens** (Dreisbach) new combination (Pl. XVI, fig. 103; pl. XIX, fig. 133; pl. XXII, fig. 162.)

Pompilinus splendens Dreisbach, 1949, Ent. Amer., (n. s.) 29: 20-21, 31, 52, figs. 53 and 54. [Type: ♂; Morton Co., Kansas, 2800 feet, 5 Aug. 1911 (F. X. Williams); Univ. Kansas.][13]

Pompilinus pseudoreductus Dreisbach, 1949, Ent. Amer., (n. s.) 29: 21-23, 31, 44, figs. 30 and 31. [Type: ♂; Muskegon, Mich., 6 Aug. 1945 (R. R. Dreisbach); M.C.Z.] New synonymy.

[?]*Pompilinus ohioensis* Dreisbach, 1949, Ent. Amer., (n. s.) 29: 24-25, 32, 44, 54, figs. 33 and 57. [Type: ♂; Pickaway Co., Ohio, 21 June 1937 (R. R. Dreisbach); M.C.Z.][14]

This species is closely allied to *marginatus,* with which it has until recently been confused. The male is best recognized by the characteristic genitalia (Fig. 103); the subgenital plate (Fig. 133) is also rather characteristic, although the small tufts of hair on each side near the base (used as a specific character for *pseudoreductus* by Dreisbach) vary in a series of otherwise similar specimens before me from rather strong to entirely absent.' What I believe to be the female of this species differs from *marginatus* in the long, low propodeum and the very long and slender antennae.

FEMALE.—Length 11 (7.5-14.5) mm. Color black, the first two abdominal tergites for the most part pale brownish-yellow, approaching orange. Wings lightly to rather heavily infuscated, with a darker marginal band. Pubescence brownish, occasionally silvery on parts of the head and thorax. Front and vertex with a few dark hairs; pronotum and front coxae slightly hairy; propodeum not at all hairy.

Clypeus about 2.5 times as broad as high, its apical margin truncate. Front rather narrow, the middle interocular distance varying from .51 to .56 times the transfacial distance. Inner orbits convergent above, the upper interocular distance about .85 times the lower. Ocellar triangle a little forward of a line drawn between the tops of the eyes, the front angle acute; postocellar line equal to or greater than the ocello-ocular. Antennae long and slender, the first four segments in a ratio of about 15:5:21:18, segment 3 equal to from .8 to 1.0 times the upper interocular distance; outer

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[13] At this writing, the type of this species is still in the possession of the describer, and I have not seen it.

[14] This species is known from a single specimen, the genitalia of which are so badly mounted as to render many of the details invisible. Although the subgenital plate is somewhat anomalous, it seems likely that this form falls within the range of variation of *splendens.* The practice of describing a species from a single poorly mounted specimen in so difficult a group as this, is, to say the least, scarcely commendable.

flagellar segments long and slender, all more than three times as long as thick.

Anterior slope of pronotum low and even, the posterior margin angulate. Propodeum (Fig. 162) rather long and slender, in full dorsal view approximately as long as its greatest width, the slope low and gradual, a little steepened behind, but the declivity not well defined. Spines of the tarsal comb about as long as the width of the tarsus; basitarsus with 3 comb-spines. Venation as in *marginatus*.

MALE.—Length 9 (6-11.5) mm. Color black, some specimens (particularly those from the southern parts of the range) marked with orange on some of the basal abdominal segments. Wings subhyaline, with a fuscous outer marginal band. Pubescence silvery over a considerable part of the head, thorax, and propodeum. Front, vertex, and anterior coxae a bit hairy; temples and propleura with considerable fine hair; body otherwise practically devoid of erect hair.

Clypeus twice as broad as high, its apical margin truncate. Front rather narrow, the middle interocular distance varying from .54 to .61 times the transfacial distance. Inner orbits subparallel or slightly convergent above. Ocelli in a right triangle, the postocellar line equal to or slightly greater than the ocello-ocular. Antennae slender, the first four segments in a ratio of about 3:1:3:3, segment 3 about 3 times as long as its greatest thickness. Pronotum angulate behind, not always sharply so. Propodeum with the median line lightly impressed. Hind basitarsus without the fringe of hairs of the preceding species.

Abdomen slender, cylindrical; sternite 6 with a V-shaped emargination apically. Subgenital plate (Fig. 133) with its margins broadly rounded, the apex slightly produced, the median line strongly elevated; the disc is clothed, except basally, with small setae; near the base on each side there is often a small tuft of setae. Genitalia (Fig. 103) with the parameres distinctly curved and expanded on the apical half, the apex itself acute; ventral surface clothed with small setae, a little stronger along the inner margin; outer margin with a series of strong setae. Basis volsellaris with a group of minute setae; digitus elongate, the inner margin nearly straight, the outer arched, the extreme apex acutely pointed; the disc is clothed with mostly straight, rather soft hairs; on the upper, outer margin are several long hairs which are more or less sinuate at their apices. Parapenials curved slightly, a little expanded toward the apex; aedoeagus somewhat expanded apically.

Biology.—This species inhabits sandy places, gardens, and other open places where the soil is light. I have taken a female along the edge of a corn field at Manhattan, Kansas, with a young spider of the genus *Lycosa* [det. B. J. Kaston], which it had hidden under a clod of earth while it apparently looked for a place to nest. Both sexes visit flowers, and have been taken on *Daucus* *carota, Polytaenia nuttallii, Melilotus alba, Vicia, Solidago, Eupatorium, Euphorbia marginata, Cleome,* and *Lepidium.* It is on the wing during the warmer months of the year, from June to September in the northern parts of the range, April to October in the southern parts.

Distribution.—Lower and Upper Austral Zones, from Georgia, Texas, and Arizona to Alberta, Manitoba, Michigan, Ontario, and Maine.

Specimens seen: 182 (114 ♀♀, 68 ♂♂). The following records are marginal: MAINE: Penobscot Co., 1 ♀, Orono, 30 Sept. [Minn.]; VERMONT: Caledonia Co., 1 ♂ [CM]; NEW YORK: Essex Co., 1 ♀, New Russia, 18 Aug. [CU]; Nassau Co., 1 ♂, Cold Spring Harbor, 24 July [AMNH]; NEW JERSEY: Burlington Co., 1 ♂, Moorestown, Summer [Minn.]; PENNSYLVANIA: Dauphin Co., 1 ♀, Deodate, 23 Aug. [CU]; Erie Co., 1 ♀, 1 ♂, Presque Isle, 7-8 July [CM]; ONTARIO: 1 ♀, Jordan, 23 Sept. [CNC]; MICHIGAN: Ingham Co., 3 ♀♀, East Lansing, 11-26 July [Coll. R. L. Fischer]; WISCONSIN: Dane Co., 1 ♀, Madison, 11 Sept. [USNM]; MINNESOTA: Ramsey Co., 2 ♀♀, 1 ♂, June-July [Minn.]; MANITOBA: 2 ♀♀, Lyleton, Aug.-Sept. [Minn.]; ALBERTA: 1 ♀, Medicine Hat, 25 Aug. [CNC]; NORTH DAKOTA: Golden Valley Co., 1 ♂, Beach, 22 Aug. [USNM]; SOUTH DAKOTA: Custer Co., 1 ♀, 2 mi. S. of Custer, 24 Aug. [HEE]; COLORADO: Prowers Co., 1 ♂, Lamar, 4-11 June [AMNH]; ARIZONA: Santa Cruz Co., 1 ♂, Sonoita, 27 July [OSC]; Cochise Co., 1 ♀, Huachuca Mts., June [CAS]; TEXAS: Brewster Co., 1 ♀, 25 mi. E. of Marathon, 7 July [HEE]; Bexar Co., 2 ♀♀, 16 June, 1 Oct. [JEG]; Galveston Co., 1 ♂, May [UK]; ALABAMA: Tuscaloosa Co., 1 ♀, 4 Oct. [HEE]; GEORGIA: Fulton Co., 1 ♂, Atlanta, 4 Aug. [HEE]; Chatham Co., 1 ♀, Tybee Island, 26 July [CU].

17. **Anoplius (Pompilinus) fraternus** (Banks) *new combination*

(Pl. XVI, fig. 104; pl. XX, fig. 137.)

Lophopompilus fraternus Banks, 1941, Canad. Ent., 73: 120. [Type: ♀; Salt Plains, Cherokee, Okla., 14 June 1935 (C. T. Brues); M.C.Z. no. 25,264.]

Pompilinus dowi Dreisbach, 1949, Ent. Amer., (n. s.) 29: 12-14, 30, 52, pl. X, figs. 51 and 52. [Type: ♂; Coconut Grove, Fla., 22 May 1937 (R. Dow); M.C.Z.] New synonymy.

Although undoubtedly closely allied to the preceding several species, *fraternus* is endowed with a number of excellent specific characters in both sexes. The clypeus of the female is distinctly emarginate medially and the head, thorax, and propodeum bear numerous erect hairs. The male subgenital plate is unusually narrow, and the parameres and digiti of the genitalia are quite unlike those of any other species of the subgenus.

FEMALE.—Length 10 (7-14) mm. Color black, the upper posterior orbits sometimes with a narrow pale stripe, the greater part of the first two abdominal tergites pale to dark orange-brown; the coloration on tergite 2 is often emarginate behind, that on tergite 1 (rarely absent) emarginate in front. Wings lightly to moderately infuscated, somewhat darker along the outer margin. Pubescence wholly brownish, obscurely violaceous. Clypeus, front, and vertex with scattered erect hairs; front coxae and pronotum distinctly hairy; scutellum and sides of the propodeum with noticeable erect hairs; mesonotum, mesopleura, middle and hind coxae, and first abdominal tergite usually somewhat hairy.

Clypeus from 2.5 to 2.8 times as broad as high, its apical margin distinctly though not sharply emarginate medially. Front of moderate, rather variable breadth, the middle interocular distance varying from .53 to .60 times the transfacial distance. Inner orbits convergent above, the upper interocular distance from .75 to .85 times the lower. Ocelli prominent, in about a right triangle, the postocellar line greater than the ocello-ocular about as 5:4. Antennae elongate, the first four segments in a ratio of roughly 6:2:9:8, segment 3 equal to from .75 to 1.2 times the upper interocular distance (this figure unusually variable).

Posterior margin of pronotum angulate. Propodeum with the median line impressed; slope more steep behind, the declivity not especially well defined. Spines of the tarsal comb about as long as the width of the tarsus; basitarsus with three comb-spines. Marginal cell of the fore wing about 1.3 times its own length from the wing-tip; third submarginal cell triangular, usually petiolate.

MALE.—Length 7.5 (5.5-10) mm. Color black, the greater part of the second abdominal tergite and usually the apex of the first tergite orange-brown. Wings subhyaline or lightly infuscated, with a darker marginal band. Pubescence varying from wholly brownish except for a little silvery on the front and clypeus, to almost wholly silvery except for parts of the abdomen and legs. Front and vertex with numerous dark hairs; front coxae and pronotum slightly hairy; remainder of thorax and the propodeum sometimes a bit hairy.

Clypeus twice as broad as high, its apical margin truncate or slightly concave. Middle interocular distance varying from .56 to .63 times the transfacial distance; upper interocular distance subequal to or a little greater or less than the lower. Ocelli prominent, in about a right triangle, the postocellar line generally somewhat greater than the ocello-ocular. Antennae slender, the first four segments in a ratio of about 15:5:16:15, segment 3 about 3 times as long as its greatest thickness. Pronotum angulate behind. Propodeum with the median line weakly impressed, the slope in profile very slight in front, suddenly declivous on the posterior fourth. Venation as in the female, the cells a bit further removed from the wing margin.

Abdomen slender, cylindrical, sternite 6 with an apical U-shaped emargination. Subgenital plate (Fig. 137) of somewhat variable shape, but always very slender, setose both above and below, the side margins near the base with a prominent series of setae. Genitalia (Fig. 104) with the parameres long, straight, of moderate breadth, a portion along the inner margin for the outer two-thirds, and along the outer margin for the outer third, including the entire apex, lightly pigmented and almost membranous; ventral surface rather evenly and sparsely setose, more prominently along the margins; dorsal surface with an area of dense setae on the apical fourth toward the outer margin. Basis volsellaris with a group of small setae; digitus much expanded apically, subspatulate, the tip acute, the shaft of the digitus rather strongly twisted about half-way out; disc of the digitus clothed with short setae, more dense below, some of which are clubbed. Parapenials slender, nearly straight; aedoeagus slightly expanded apically.

Biology.—This species is characteristic of, and perhaps restricted to, sea beaches and inland saline areas. In such places it is often common, though there are broad intervening areas where it does not appear to occur. Both sexes are usually found close to the ground, flying irregularly over the sand or mud, often in the vicinity of seaweed or other vegetation. I have taken a single female on the beach near Port Isabel, Texas, with a spider of the genus *Lycosa* (juvenile) [det. B. J. Kaston]. The species is not known to visit flowers.

Distribution.—Lower and Upper Austral zones, Texas and Florida to Colorado, Nebraska, and Long Island, New York. As noted above, this species is very local in its distribution.

Specimens seen: 85 (47 ♀♀, 38 ♂♂). NEW YORK: Nassau Co., 1 ♀, 2 ♂♂, Sea Cliff, July [MCZ]; NEW JERSEY: Cape May Co., 2 ♀♀, 1 ♂, 14 June, 16 Aug. [ANSP, USNM]; GEORGIA: Chatham Co., 1 ♀, Tybee Island, 26 July [CU]; FLORIDA: Collier Co., 1 ♂, Marco, 17 Apr. [AMNH]; Dade Co., 1 ♂, Coconut Grove, 22 May [MCZ]; Lee Co., 2 ♂♂, Punta Rassa, 12 May [CU]; Monroe Co., 1 ♀, Long Key, 23 July [UK]; Volusia Co., 1 ♀, Coronado Beach, 5 May [CU]; TEXAS: Brazos Co., 1 ♀, 29 Apr. [JEG]; Cameron Co., 15 ♀♀, 11 ♂♂, Port Isabel, 20-23 June [HEE]; Galveston Co., 1 ♀, 2 ♂♂, March-Aug. [USNM, Minn., RWS]; Hidalgo Co., 1 ♀, 23-25 June [HEE]; Kenedy Co., 6 ♀♀, 2 ♂♂, Los Olmos Creek, 18 June [HEE]; Kleburg Co., 4 ♀♀, Riviera Beach, 18 June [HEE]; OKLAHOMA: Alfalfa Co., 2 ♀♀, Salt Plains, Cherokee, 14 June [MCZ]; KANSAS: Stafford Co., 4 ♀♀, 15 ♂♂, Salt flats, 27 May [HEE];

NEBRASKA: Lancaster Co., 7 ♀♀, Lincoln, 29 June, 8-9 Sept. [Minn.]; COLORADO: Logan Co., 1 ♂, Crook, 15 June [MCZ].

F. Subgenus **ANOPLIUS** Dufour

Anoplius Dufour, 1834, Ann. Soc. Ent. France, 2: 483. [Type: *Pompilus niger* Fabricius, 1775 (=*nigerrimus* Scopoli, 1763); designated by Fox, 1901.]—Banks, 1912, Jour. N. Y. Ent. Soc., 19: 224.—Banks, 1917, Bull. Mus. Comp. Zool., 61: 107.—Dreisbach, 1949, Ent. Amer., (n. s.) 29: 7, 11.—Dreisbach, 1950, Amer. Midl. Nat., 43: 574-590. [Key to males.]

Pompilioides Radoszkowski, 1887, Hor. Soc. Ent. Ross., 21: 94. [Type: *Pompilioides unicolor* Radoszkowski, 1887; designated by Ashmead, 1902.]

Aphiloctenus Ashmead, 1902, Canad. Ent., 34: 87. [Type: *Pompilus virginiensis* Cresson, 1867; monobasic.]

The females of this subgenus do not possess a tarsal comb, though in some cases the tarsi are rather spinose. Instead of the single distinct spine at the middle of the second tarsal segment on the outer side, there are two very minute spines in this position. The pygidium of the female is densely bristly, and by this character the members of this group may be told from those of the subgenus *Anoplochares* of the genus *Pompilus*, with which they are sometimes confused. Males belonging to this subgenus may be recognized by having the slope of the propodeum low and even, not steepened behind, and by having the transverse median vein of the fore wing meeting the media beyond the origin of the basal vein (rarely interstitial). The male venter is often hirsute, and some species bear dense brushes of hair on some of the sternites, much as in some species of *Arachnophroctonus* and *Anopliodes;* in the genitalia the parameres tend to be of not exceptional length, usually slender or at least not broadened apically.

Subgeneric characters.—Small to medium-sized wasps, length 4.5 to 20 mm.; Nearctic species with the integument wholly black or blue-black. Amount of erect hair on the body rather variable, usually greater than in *Pompilinus*; propodeum usually but not always hairy; male venter at least slightly hirsute, sometimes strongly hairy; female pygidium densely bristly. Mandibles either unidentate or bidentate. Apical margin of clypeus truncate or excised very slightly. Malar space practically absent; temples never strongly developed; vertex never raised more than very slightly above the tops of the eyes. Antennae rather long and slender.

Pronotum short, its posterior margin usually distinctly angulate, but in one species nearly arcuate. Propodeum not strongly convex longitudinally, the slope low and rather even; in the female it may be somewhat steepened behind, but the declivity is never well defined; in the male the profile is low and even from front to rear (as in Fig. 147). Tarsal comb of the female absent; basitarsus of this sex with two rows of spines (Fig. 166), those of the upper row ("U" in Fig. 166) less strong than those of the lower ("L" in Fig. 166), and sometimes scarcely visible; second tarsal segment with from one to three very small spines on the outer side (Fig. 167). Last segment of front tarsus of the male slightly to rather strongly lobed on the inner margin (Figs. 163 and 164), the inner claw of this tarsus strongly modified, the outer slightly so. Pulvillar comb well developed, in the female of from 14 to 20 setulae. Transverse median vein of fore wing meeting the media beyond the origin of the basal (occasionally they are interstitial). Stigma small to fairly large. Marginal cell rather large, sometimes less than its own length from the wing-tip. Third submarginal cell narrowed above by the arcuation of the third transverse cubital vein, but only occasionally triangular, infrequently petiolate. (Wings of one species shown in Fig. 154.)

Abdomen of the male elongate-subfusiform, less uniformly cylindrical than in *Pompilinus*, sometimes rather slender basally, almost petiolate. Subgenital plate of very variable shape. Genitalia with the parameres of most of the species rather short, frequently shorter than the aedoeagus, usually tapering beyond the prominent squamae (but not so in the genotype); digiti variously shaped, never with long hairs on the upper outer margins; basal hooklets single, the tip often somewhat bifid; aedoeagus of moderate breadth, the apex more or less rounded, with the usual median cleft.

Biology.—The species of *Anoplius s. str.* are rather various in their habits; none of the species seem to be strict psammophiles. Some of the species inhabit restricted ecological niches and prey only on certain genera of spiders, while others are more wide-ranging and less selective of their prey. Several species seem to use ready-made cavities of various kinds for nests, but others are apparently able to construct galleries in the earth in spite of the absence of a tarsal comb. Some of the species visit flowers frequently, others rarely or not at all. In general, not much is known of the habits of our native species, but brief accounts of the biology of a few are included in the following pages.

Distribution.—I have seen species belonging to this subgenus from the Nearctic, Neotropical, Palaearctic, and Oriental regions. Ten species inhabit our fauna.

Key to Species

Females

1. Either (a) the hind coxae conspicuously silvery-sericeous above, *or* (b) the front basitarsus weakly spined, the spines of the upper row minute, either very short or longer but setiform (Figs. 168-170), *or* (c) the claws of each pair unequal, the inner larger than the outer, both more or less bifid (Fig. 144) (*Nigerrimus*-group) 2

   None of the above conditions true; hind coxae never at all silvery; front basitarsus fairly strongly spined, the upper row of three spines which are usually half or more as long as the width of the tarsus, the lower row of three or four spines which are in part, at least, as long as the width of the tarsus (Figs. 166 and 167); claws normal, dentate and of equal size (*Illinoensis*-group) 8

2. Basal four segments of all the tarsi distinctly flattened on one side, the tarsus thus more or less semicircular in cross-section; front basitarsus ridged along the upper, nearly obsolete, row of spines (Fig. 169); pronotum not sharply angulate behind, nearly arcuate.
   2. **depressipes** Banks

   Tarsi normal, circular in cross-section; front basitarsus not ridged along the upper spine-row; pronotum distinctly angulate behind 3

3. Claws bifid, the tooth sloping outward, the claws of each pair unequal, the inner claw much larger than the outer (Fig. 144); spines beneath the apical tarsal segments rather long; stigma rather large.
   3. **ithaca** (Banks)

   Claws normal, the tooth short and erect, the inner claws not larger than the outer; stigma small 4

4. Ground color of body a brilliant metallic blue or lavender, fading to violet in older specimens; front and vertex narrow, the third antennal segment equal to or greater than the upper interocular distance; spines of the upper row on the front basitarsus fairly long, but very slender, setiform (Fig. 168) ....4. **fulgidus** (Cresson)

   Ground color black, at most with the pubescence obscurely violaceous; spines of the upper row inconspicuous 5

5. Front and vertex narrow, the third antennal segment subequal to the upper interocular distance (.9 to 1.2 times it), the middle interocular distance at most .58 times the transfacial distance, usually about .55 times it; third submarginal cell always 4-sided.
   5. **virginiensis** (Cresson)

   Front and vertex broader; third antennal segment equal to from .6 to .9 the upper interocular distance; middle interocular distance equal to from .57 to .62 times the transfacial distance; third submarginal cell often triangular or nearly so, sometimes petiolate 6

6. Clypeus only a little over twice as broad as high, the apical margin slightly emarginate (Fig. 159); third submarginal cell triangular, usually petiolate ....6. **hispidulus** Dreisbach

Clypeus at least 2.5 times as broad as high, the apical margin only slightly concave (Fig. 160); third submarginal cell occasionally petiolate 7

7. Head and thorax not strongly hairy; middle and hind coxae and propodeum only very slightly if at all hairy; spines of the upper row on the front basitarsus very minute ....1. **nigerrimus** (Scopoli)

Head and thorax with abundant erect hair; propodeum and usually the middle and hind coxae rather strongly hairy; spines of the upper row on the front basitarsus a little longer, but very slender. 7. **basalis** Dreisbach

8. Length 7.5 (5-10) mm.; inner orbits barely if at all convergent above; third transverse cubital vein strongly arched, the third submarginal cell varying from triangular to fairly wide above; pubescence dark, obscurely violaceous ....8. **imbellis** Banks

Length 12 (8.5-16) mm.; inner orbits convergent above, the upper interocular distance usually about .9 the lower; third submarginal cell never completely triangular; pubescence variable, sometimes strongly bluish 9

9. Mesopleura not hairy, propodeum slightly to moderately hairy; spines of the upper row on the front basitarsus strong, usually about as long as the width of the tarsus (Fig. 166) .....9. **illinoensis** (Robertson)

Mesopleura with at least a few prominent erect hairs; head, thorax, and propodeum in general more hairy than above; spines of the upper row on the basitarsus shorter, at most a little more than half as long as the width of the tarsus (about as in Fig. 167) 10

10. Pubescence fuscous or brownish, obscurely reflecting deep metallic colors; wings only slightly violaceous; head and thorax slightly less hairy than below ....10a. **ventralis ventralis** (Banks)

Pubescence strongly reflecting deep bluish or violaceous over the entire body; wings strongly violaceous; head, thorax, and propodeum very conspicuously hairy ....10b. **ventralis tarsatus** Banks

Males

1. Abdominal sternites without dense brushes of long hairs, either almost smooth, or with brushes of less dense, short hairs (Figs. 149 and 150); last segment of front tarsus slightly produced on the inner margin, this segment widest about two-thirds the distance from the base, more than 1.5 times as long as broad (Fig. 163) (*Nigerrimus*-group) 2

Sternites 4 and 5 with dense brushes of rather long hairs (Figs. 147 and 148); last segment of front tarsus more strongly produced on the inner margin, the segment widest about midway, and only about 1.5 times as long as broad (Fig. 164) (*Illinoensis*-group) 7

2. Body entirely a brilliant deep blue, violet, or blue-green; subgenital plate very broad, the surface flat or somewhat folded medially, clothed, especially along the outer margin, with fairly long setae. 4. **fulgidus** (Cresson)

Ground color black; subgenital plate not of this form, either slender and acute apically, or else strongly elevated medially 3

3. Stigma very large, at least a third as long as the marginal cell; subgenital plate very broad, folded roof-like beneath the apex of the abdomen; parameres of genitalia very short (Fig. 107). 3. **ithaca** (Banks)

Stigma smaller, only a small fraction of the length of the marginal cell; subgenital plate not as broad, though sometimes of moderate breadth and somewhat elevated medially; parameres longer 4

4. Subgenital plate rather broad, the apex obtusely pointed, the median line sharply elevated (Fig. 140); venter rather hirsute, but the setae showing little tendency to form brushes; parameres moderately to very broad 5

Subgenital plate slender apically, the tip acute (Fig. 138); setae on sternites 3 to 5 fairly dense, tending to form weak brushes (Figs. 149 and 150); parameres slender 6

5. Propodeum hairy; third submarginal cell wide above; minimum size 9 mm.; digiti broad, subspatulate (Fig. 105) ....2. **depressipes** Banks

Propodeum not or but slightly hairy; third submarginal cell triangular or nearly so, sometimes petiolate; maximum size 9 mm.; digiti very slender (Fig. 106) ....1. **nigerrimus** (Scopoli)

6. Third submarginal cell narrowed above, rarely completely triangular, never petiolate; subgenital plate acutely pointed apically; parameres not much if any exceeding the other appendages (Fig. 108). 5. **virginiensis** (Cresson)

Third submarginal cell triangular, usually petiolate; subgenital plate extremely slender and attenuate apically; parameres very strong, much longer than the other appendages (Fig. 110). 6. **hispidulus** Dreisbach

7. Coxae at least in part silvery-sericeous; parameres of genitalia very broad near the base (Fig. 111). ....7. **basalis** Dreisbach

Silvery pubescence, if present at all, restricted to the lower front and clypeus; parameres at most very slightly broader near the base than apically 8

8. Subgenital plate but slightly raised medially, the sides tapering gradually, the apex narrowly rounded and fringed with a rather even row of bristles (Fig. 142); emargination of sternite 6 broadly U-shaped. 8. **imbellis** Banks

Subgenital plate more or less keeled, the apex subacute, somewhat bushy-haired (Figs. 141 and 143); emargination of sternite 6 more narrow, somewhat V-shaped 9

9. Scape and propodeum not or only very slightly hairy; sternite 3 with at most a few setae; digitus volsellaris more or less triangular apically, the inner margin with a group of setae which are directed mesad (Fig. 113) ....9. **illinoensis** (Robertson)

Scape and propodeum both rather hairy; sternite 3 frequently with numerous hairs, sometimes forming a brush; digiti somewhat spindle-shaped 10

10. Pubescence fuscous or brownish, at most rather vaguely violaceous or bluish; wings not or scarcely violaceous; digitus with a strip along the inner margin which is devoid of setae (Fig. 114).
10a. **ventralis ventralis** (Banks)

Pubescence over most of the body strongly reflecting dark bluish, fading to violet in older specimens; wings more or less violaceous; setae on the digitus distributed over the whole surface (Fig. 115)
10b. **ventralis tarsatus** Banks

Nigerrimus Species-group

To this group belong several species closely resembling the Holarctic *nigerrimus* and possibly derivatives of it. In these species the front basitarsus of the female is weakly spined (except in *ithaca*), and the hind coxae are often somewhat silvery-sericeous. In the male the last segment of the front tarsus is less strongly produced on the inner margin than in the following species-group, and the venter is without the long brushes of hair characteristic of that group. One species, *basalis*, is placed here on the characters of the female, although the males agree with the *illinoensis*-group, with which this form may be annectant.

1. **Anoplius (Anoplius) nigerrimus** (Scopoli)
(Pl. XVI, fig. 106; pl. XX, fig. 140; pl. XXII, fig. 163.)

Sphex nigerrima Scopoli, 1763, Entomologia Carniolica, p. 295. [Type: ♀; Carniola (i. e., northwestern Yugoslavia); (location of type, if extant, not known to present author).]

Sphex nigra Fabricius, 1775, Systema Entomologiae, p. 350. [Type: ♀?; "Europe"; (location of type not known to present author).]

Pompilus niger Panzer, 1804, Fauna Insectorum Germaniae, p. 71.

Anoplius nigerrimus Berland, 1925, Faune de France X, Hymen. Vespiformes I, pp. 249-252.—Haupt, 1927, Deutsch. Ent. Zeitschr., Beiheft, p. 241.—Richards and Hamm, 1939, Trans. Soc. Brit. Ent., 6: 98-100. [Biology.]—Wilcke, 1943, Overdruk uit Med. van de Landbouwhoogeschool Wageningen, 47: 78, & fig. 77.—Strickland, 1947, Canad. Ent., 79: 125. [Edmonton, Alta.]

Anoplius wheeleri Banks, 1939, Canad. Ent., 71: 228. [Type: ♀; Colebrook, Conn. (W. M. Wheeler); M.C.Z. no. 23,482.][15] New synonymy.

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[15] Banks' paratypes [MCZ] are a mixture of this species and *Pompilus apicatus* Provancher.

Anoplius banksi Dreisbach, 1950, Amer. Midl. Nat., 43: 579-581, 589, figs. 13 and 14. [Type: ♂; Midland Co., Mich., 22 June 1946 (R. R. Dreisbach); M.C.Z.] New synonymy.

This is a common Palaearctic species; a complete list of references for the European fauna cannot be given here, but the reader is referred to Haupt (1927). Banks' *wheeleri* and Dreisbach's *banksi* have been placed in synonymy with *nigerrimus* after a careful study of two series of European specimens, of both sexes, determined as this species by Kohl and by Wilcke. The American and European specimens agree in all essentials, including the very distinctive male genitalia.

FEMALE.—Length 8.8 (6-11) mm. Color black, the upper outer orbits sometimes with a small pale mark. Fore wings lightly infuscated or nearly hyaline, with a darker marginal band; hind wings subhyaline, darker apically. Pubescence mostly fuscous, but silvery at least on the posterior part of the middle and hind coxae; occasionally the silvery pubescence extends over much of the head and thorax and even forms weak bands on the bases of the abdominal tergites. Clypeus, front, vertex, and front coxae slightly hairy; middle and hind coxae at most very slightly hairy, the femora not at all so; propodeum either without erect hairs or with a few scattered, rather inconspicuous hairs.

Clypeus about 2.5 times as broad as high, its apical margin slightly arcuately concave. Front broad, the middle interocular distance varying from .57 to .62 times the transfacial distance. Inner orbits converging slightly above, the upper interocular distance from .85 to .9 times the lower. Ocelli forming a right or acute angle in front, the postocellar line slightly less than the ocello-ocular. Antennae of moderate length, the first four segments in a ratio of about 3:1:4:3, segment 3 equal to from .65 to .85 times the upper interocular distance. Front, in profile, rather strongly convex; temples strong.

Posterior pronotal margin sharply angulate. Median line of propodeum impressed. Front basitarsus weakly spined, the spines of the upper row stout but short, less than half as long as the basitarsus is wide, the spines of the lower row of somewhat variable length, one or two of them sometimes as long as the width of the basitarsus. Fore wing with the stigma short; marginal cell of moderate length, usually very slightly more than its own length from the wing-tip. Second submarginal cell trapezoidal, slightly longer than high, narrowed by about a third above; third submarginal cell of about the same length as the second, much more strongly narrowed above, nearly or quite triangular, rarely short-petiolate.

MALE.—Length 7.5 (6-9) mm. Color black; wings hyaline or nearly so, the outer margins with a fuscous band. Pubescence brownish-fuscous, except silvery as follows: lower front, sides of clypeus, coxae in great part, lower pleura, propodeum, and often a suggestion of bands on the bases of the first three abdominal tergites; occasionally almost the whole head and thorax are silvery. Clypeus, front, vertex, temples, propleura, and front coxae slightly hairy; pronotum and propodeum usually with a few inconspicuous hairs; abdominal sternites 4, 5, and 6, and the subgenital plate, with rather abundant short, suberect setae.

Clypeus about 2.3 times as broad as high; front broad, the middle interocular distance from .6 to .65 times the transfacial. Eyes diverging very slightly above; ocelli as in female. First four antennal segments in a ratio of about 3:1:3:3, segment 3 about 2.5 times as long as thick. Posterior pronotal margin sharply angulate. Median line of propodeum impressed or not. Last segment of front tarsus produced on the inner side, though not strongly. Inner claw of front tarsus strongly curved, deeply cleft, outer claw much less so, but more so than the claws of the middle and hind tarsus. Venation about as in the female; second submarginal cell usually not longer than high; third submarginal cell usually triangular.

Abdomen slender, especially toward the base; first tergite not strongly swollen, in profile sloping very slightly. Sternites without well-defined brushes of hair, but sternites 4 to 7 with abundant short setae. Emargination of sternite 6 V-shaped. Subgenital plate (Fig. 140) rather broad, the apex obtuse; median line strongly elevated for its entire length; disc, margins, and especially the median elevation with abundant hairs of moderate length. Genitalia (Fig. 106) unique in that the parameres are very broad, apically broadly rounded or subtruncate; squamae strong, protuberant; outer margin and apex clothed with long hairs, the ventral surface clothed uniformly with smaller setae. Basis volsellaris with a few small setae; digiti very slender, acuminate, clothed with short, straight setae. Parapenials straight and slender; aedoeagus rather broad, its margins uniformly arched from base to apex, the apex deeply cleft medially.

Biology.—There are no published observations on the habits of this species in this country. In Europe its biology has been studied by a number of workers, especially Nielsen and Ferton; this information has been summarized by Richards and Hamm (1939). They state that the species " is not especially attached to sandy soils, but is often found on banks or walls in heathy or marshy places." Ready-made cavities of many sorts are used in nesting, including hollow twigs, under stones, and in the deserted tunnels of bees. These authors have compiled a considerable list of spiders known to serve as prey; these are chiefly Lycosidae, with few records of Pisauridae and Gnaphosidae.

in the Hudsonian and Canadian Zones, entering the Transition Zone sparingly.

Specimens seen: 124 (90 ♀♀, 34 ♂♂). The following records are marginal: NEWFOUNDLAND: 1 ♀, Spruce Brook, 29 July [CNC]; QUEBEC: 1 ♀, east coast of James Bay, 19 July [CNC]; NORTHWEST TERRITORIES: 1 ♀, Cameron Bay, Great Bear Lake, 1 July [CNC]; 1 ♀, Fort Norman, McKenzie R., 9 Aug. [CNC]; YUKON: 1 ♂, Marsh Lake, 10 July [CNC]; OREGON: Klamath Co., 1 ♀, Aspen Lake, 26 June [CAS]; UTAH: Kane Co., 1 ♂, 10 mi. N. of Orderville, 5500 feet, 14 Aug. [HEE]; COLORADO: Rocky Mt. Nat. Park, 2 ♀♀, Trail Ridge, 12,000 feet, Aug. [MCZ]; SASKATCHEWAN: 1 ♀, Regina, 8 Aug. [CNC]; MANITOBA: 1 ♀, Aweme, 12 July [CNC]; MINNESOTA: Itasca Co., 1 ♀, Grand Rapids, 7 July [Minn.]; Chisago Co., 1 ♀ [Minn.]; WISCONSIN: Sawyer Co., 1 ♂, 1-8 Aug. [Minn.]; MICHIGAN: Gratiot Co., 1 ♀, June [Coll. R. R. Dreisbach]; ONTARIO: 1 ♂, Ingersoll, 25 June [CNC]; PENNSYLVANIA: Allegheny Co., 1 ♀, Sample Station, 15 July [CM]; Sullivan Co., 1 ♀, Lopez, 4-15 Aug. [ANSP]; CONNECTICUT: Litchfield Co., 7 ♀♀, Colebrook [MCZ]; MASSACHUSETTS: Suffolk Co., 2 ♀♀, Forest Hills, Aug. [CAS].

2. **Anoplius (Anoplius) depressipes** Banks

(Pl. XVI, fig. 105; pl. XXII, fig. 169.)

Anoplius depressipes Banks, 1919, Canad. Ent., 51:81. [Type: ♀; Ithaca, N. Y., 12 July 1912; C. U. no. 677.]—Evans, 1949, Proc. Ent. Soc. Wash., 51: 206-208. [Biology.]—Dreisbach, 1950, Amer. Midl. Nat., 43: 582.

Anoplius illinoiensis [*sic*] Caudell, 1922, Proc. Ent. Soc. Wash., 24: 125-126. [*Nec* Robertson; misidentification.] [Biology.]

Psammochares (*Anoplius*) *depressipes* Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 987.

This species is closely allied to the preceding, and may be a derivative of it. The male subgenital plate is very similar to that of *nigerrimus,* but the genitalia are very different, and the propodeum is conspicuously hairy. The female may be recognized at once by the unusual tarsi: the basal four segments of all the tarsi are distinctly flattened on one side, in cross-section thus being semicircular instead of circular; on the middle and hind tarsi there is a small fringe of setae along the edge of this flattened portion. This may well be an adaptation for the semi-aquatic habits of this wasp, possibly to permit it to walk on the surface film. (See remarks under *Biology.*)

FEMALE.—Length 14 (11-20) mm. Color black; wings fuliginous, somewhat violaceous. Pubescence fusco-violaceous, sometimes with small patches of silvery pubescence on the front coxae in front and the middle and hind coxae behind, sometimes also on the sides of the clypeus. Body in general rather hairy; scape slightly hairy or not; head, thorax, coxae, and propodeum all rather prominently hairy, but the femora not or scarcely so.

Mandibles bidentate, the two teeth strong and rather close to the apex. Clypeus about 2.4 times as broad as high, the apical margin broadly truncate. Front of moderate breadth, the middle interocular distance from .55 to .6 times the transfacial. Inner orbits converging slightly above, the upper interocular distance from .85 to .9 times the lower. Ocelli in a small triangle, the front angle right or acute; postocellar line less than the ocello-ocular as 4:5. Antennae elongate, the first four segments in a ratio of about 4:1:7:5, segment 3 equal to or greater than the upper interocular distance. Front rather flat transversely; line from the antennal bases to front ocellus very distinct; temples narrow.

Posterior margin of the pronotum subangulate or subarcuate, never distinctly angulate as in related species. Propodeum with the slope low and even, the median line impressed. Legs weakly spined; basal four segments of the front tarsus flattened or slightly hollowed out on the lower outer side, the basitarsus ridged along the line of the upper row of spines, which are very small (Fig. 169). Middle and hind tarsi also flattened on one side (except the apical segment), in this case the inner side, the ridge on the outer side of this flattened portion bearing a small fringe of setae. Fore wing with the stigma rather short, the marginal cell long, about or less than its own length from the wing-tip. Second submarginal cell trapezoidal, wider than high; third submarginal generally wider than the second, narrowed by half to two-thirds above.

MALE.—Length 12 (9-14.5) mm. Color black; wings nearly hyaline at the extreme base, becoming gradually more infuscated toward the outer margin, the margin with a distinct fuscous band. Pubescence fusco-violaceous, silvery as follows: sides of lower front and clypeus, front of anterior coxae, middle and hind coxae above, lower portion of mesopleura, and posterior slope of propodeum. Head, thorax, and propodeum with abundant dark erect hair as in the female; first abdominal tergite rather hairy; venter with scattered short, suberect setae, showing little tendency to form brushes.

Clypeus slightly over twice as broad as high. Middle interocular distance varying from .58 to .6 times the transfacial distance; inner orbits subparallel, the upper interocular distance subequal to or slightly greater than the lower. Ocelli as in the female. First four antennal segments in a ratio of about 3:1:3.2:3, segment 3 about 3 times as long as thick. Pronotum subarcuate or indistinctly angulate behind. Propodeum rather short, the median line weakly impressed or not. Last segment of front

Abdomen subfusiform, slightly flattened dorsally. Venter somewhat hirsute, as described above. Subgenital plate and the preceding sternite practically the same as in *nigerrimus*. Genitalia (Fig. 105) with the parameres short, of moderate breadth, long-setose; basis volsellaris with a few setae; digitus much broadened apically, clothed with semierect, straight setae of moderate length. Parapenials simple, straight; aedoeagus rather broad, shaped much as in *nigerrimus*.

Biology.—This species occurs along still or slow-moving inland waterways, where it preys upon large semiaquatic spiders of the genus *Dolomedes* (Pisauridae). Like its prey, this wasp is apparently able to walk on the surface film of the water and even to dive beneath the surface and walk on the bottom and on aquatic vegetation. The nest of the wasp is a burrow in the stream-bank, and the spider is transported to its nest by the remarkable method of flying over the surface film towing the spider behind. Several observers have noted this behavior, and these notes have recently been summarized by the author (Evans, 1949). Since the publication of this paper, my attention has been drawn to still another series of observations on the behavior of this wasp, published by Phil Rau in a paper entitled " Pompilid wasps and prey-transportation by water ".[16] While Rau did not identify the wasp, his notes leave little doubt that he was dealing with this species. His observations were made in parts of Missouri and Kansas which are well within the known range of *depressipes*.

This species is on the wing from late May until early August, and probably has but one generation a year. I have taken an occasional specimen at honeydew and on the flowers of poison hemlock, *Conium maculatum*.

Distribution.—This wasp occurs over most of the eastern half of the United States, from Florida, Alabama, and Kansas north to Minnesota, Michigan, and Maine.

Specimens seen: 60 (29 ♀♀, 31 ♂♂). MAINE: Cumberland Co., 1 ♀, 1 ♂, Casco, 1-2 Aug. [CU]; MASSACHUSETTS: Middlesex Co., 1 ♀, Stony Brook Res. [MCZ]; Norfolk Co., 1 ♀, Wellesley, July [MCZ]; NEW YORK: Tompkins Co., 1 ♀, Ithaca, 12 July [CU]; 1 ♀, Renwick, 12 Aug. [Minn.]; Westchester Co., 1 ♀, White Plains [MCZ]; PENNSYLVANIA: 1 ♂ (no further data) [USNM]; Centre Co., 1 ♀, Tussyville Gap, 11 July [PSC]; Butler Co., 1 ♀, Slippery Rock Creek, 13 July [CM]; NEW JERSEY:

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[16] Rau, Phil, 1934, Psyche, 41: 241-242.

Bergen Co., 1 ♀, W. Englewood, July [MCZ]; Camden Co., 1 ♂, Berlin, 1 June [CU]; Cumberland Co., 1 ♀, Vineland, 25 June [CU]; MARYLAND: Montgomery Co., 1 ♂, Cabin John, 8 June [USNM]; 1 ♀, Great Falls, 4 July [USNM]; VIRGINIA: Lee Co., 1 ♀, Stone Creek [MCZ]; WEST VIRGINIA: Randolph Co., 1 ♀, Cheat Mt., June [CM]; NORTH CAROLINA: Wake Co., 1 ♀, 2 ♂♂, Raleigh, May [USNM]; GEORGIA: 1 ♀, Burton, 21 May [CU]; Decatur Co., 1 ♀, Spring Creek, July [MCZ]; 1 ♂, Bainbridge, Sept. [MCZ]; FLORIDA: Pasco Co., 1 ♀, Lacoochee, 7 July [UK]; ALABAMA: Washington Co., 1 ♀, LeRoy, June [MCZ]; KANSAS: Riley Co., 5 ♀♀, 24 ♂♂, Deep Creek, 30 May-10 June [KSC, HEE]; Marshall Co., 1 ♀, Marysville, 15 June [KSC]; MINNESOTA: Nicollet Co., 1 ♀, St. Peter, 25 July [Minn.]; Ramsey Co., 1 ♀, St. Paul, 18 July [Minn.]; WISCONSIN: Wood Co., 2 ♀♀, Cranmoor, 13-17 July [USNM]; MICHIGAN: Roscommon Co., 1 ♀, 3 Aug. [Coll. R. R. Dreisbach].

3. **Anoplius (Anoplius) ithaca** (Banks)

(Pl. XVI, fig. 107; pl. XX, fig. 144.)

Psammochares ithaca Banks, 1912, Jour. N. Y. Ent. Soc., 19: 224. [Type: ♀; Ithaca, N. Y., 1-7 July; M.C.Z. no. 13,699.]

Psammochares (*Anoplius*) *ithaca* Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 987.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 128. [Raleigh, N. C.]—Brimley, 1938, Insects No. Carolina, p. 434.

Anoplius selkirkensis Banks, 1919, Bull. Mus. Comp. Zool., 63: 234. [Type: ♀; Downie Creek, Selkirk Mts., B. C., 14 Aug. 1905 (J. C. Bradley); C. U. no. 685.] New synonymy.

Anoplius ithaca Strickland, 1947, Canad. Ent., 79: 125. [Medicine Hat, Alta.]

Anoplius (*Anoplius*) *ithaca* Evans, 1948, Ent. News, 59: 180-183. [Biology.]

Anoplius ithica [*sic*] Dreisbach, 1950, Amer. Midl. Nat., 43: 575, 583-584, 589, figs. 15 and 16.

This species, while doubtless derived from stock resembling *nigerrimus*, has become rather specialized with regard to the legs, which are unusually spinose for this species-group, and the tarsal claws, which (especially in the female) are large, bifid, and asymmetrical. These are probably adaptations for the stone-loving habits of this wasp (see notes under *Biology*). Haupt[17] has proposed the generic name *Paranoplius* for certain Old World species also possessing asymmetrical claws. I have not seen specimens of the genotype, *separatus* Haupt, but it is possible that it is closely related to *ithaca*. If this proves to be true, *Paranoplius* may be regarded a synonym of *Anoplius*.

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[17] Haupt, H., 1929, Mitt. Zool. Mus. Berlin, 15: 118, 144.

FEMALE.—Length 8 (5.5-11) mm. Color black; fore wings hyaline basally, becoming gradually somewhat infuscated toward the apex, the outer margin with a darker fuscous band, the veins and stigma brownish; hind wings hyaline, the apex infuscated. Pubescence mostly fusco-violaceous or somewhat brownish, often silvery on the hind coxae above, often much more extensively silvery, sometimes even to the extent of having silvery bands at the bases of the basal abdominal tergites. Clypeus, front, vertex, temples, prothorax, and propodeum all with rather abundant dark erect hair; mesonotum, scutellum, pleurites, coxae, and first abdominal tergite also generally somewhat hairy.

Mandibles unidentate. Clypeus about three times as broad as high, truncate below. Front broad, the middle interocular distance varying from .56 to .62 times the transfacial. Inner orbits slightly convergent above, the upper interocular distance about .9 the lower. Vertex broad, nearly straight across at the eye-tops; ocelli forming a right or acute angle in front; post-ocellar line: ocello-ocular line about as 4:5. First four antennal segments in a ratio of about 3:1:5:4, segment 3 varying from .7 to 1.0 times the upper interocular distance.

Posterior pronotal margin angulate. Propodeum with a strongly impressed median groove. Legs strongly spinose; front basitarsus with the spines of both the upper and lower rows strong, at least in part as long as the thickness of the tarsus. Apical tarsal segments (Fig. 144) with the spines of the median row 3 to 5 in number, becoming increasingly long distad; usually there are a few shorter lateral spines on these segments; claws large, bifid, the inner claw of each pair distinctly longer than the outer, and about as long as the last tarsal segment. Fore wing with the basal and transverse median veins either interstitial or disjointed. Stigma very large, dark brown, the lower margin arcuate. Marginal cell about or a little less than its own length from the wing-tip; second and third submarginal cells subequal in breadth, the second narrowed by about a third above, the third narrowed by from .4 to .8 above.

MALE.—Length 6.5 (4.5-9) mm. Color black; wings nearly hyaline, the veins and stigma brownish, the fore wings with a fuscous marginal band which extends through the upper half of the marginal cell. Head and thorax often in large part silvery-sericeous; basal four abdominal segments frequently with basal silvery bands. Clypeus, front, temples, and propleura with numerous dark erect hairs; front coxae, thoracic dorsum, and propodeum slightly hairy; venter and apical tergites with sparse suberect hairs.

Clypeus from 2.6 to 3 times as broad as high, broadly truncate below. Middle interocular distance from .61 to .66 times the transfacial; inner orbits diverging slightly or not at all above. Ocelli as in the female. First four antennal segments in a ratio of about 27:10:32:30, segment

3 about 3 times as long as thick. Pronotum sharply angulate behind. Postnotum nearly as long as the metanotum, somewhat striate; propodeum with a median groove. Last segment of front tarsus produced on the inner margin, less than twice as long as its maximum width. Inner claw of front tarsus very strongly curved, the inner ray short and rounded; outer claw of front tarsus moderately curved, the inner ray about half as long as the outer (measured from the split); remaining claws less strongly bent, the inner ray nearly as long as the outer; claws of each pair only slightly unequal, less so than in the female. Venation much as in the female, the stigma more than twice as long as high, and more than one third the total length of the marginal cell. In many individuals the basal and transverse median veins of the fore wing are interstitial on the media.

Abdominal sternite 6 with the emargination U-shaped, rather shallow. Subgenital plate unusually broad, strongly folded medially, forming an inverted roof-shaped closure for the genital chamber. Genitalia (Fig. 107) with the parameres very short, much exceeded by all the other appendages (though sometimes somewhat longer than shown in figure); basis volsellaris with several rather long setae in a group; digiti slender, curved almost at right-angles about midway, the apical half clothed with short setae, more dense apically; parapenials simple and slender, slightly exceeded by the aedoeagus.

Biology.—This species is confined to stony stream-sides, where it may sometimes be found in considerable numbers flying and running over the rocks. The prey consists largely if not exclusively of small spiders of the genus *Pardosa* (Lycosidae), which are common in the same habitat. Since publishing several prey records (Evans, 1948), I have taken still another specimen, this one in Bosque Co., Texas, with a spider of this same genus. The nest is a short gallery among the stones or in gravel. It is interesting that two species closely related to and possibly derived from *nigerrimus,* a wide-ranging species showing little selection of its prey, have each come to be restricted to a distinct ecological niche and to a single genus of spiders. I refer to *depressipes,* which occurs along ponds or sluggish streams and preys on *Dolomedes,* and the present species. Both exhibit certain specializations in their tarsi which may fit them for their habits. I have on one occasion taken the two species together, along a rocky stream in which there were numerous quiet pools.

Anoplius ithaca appears to have several (perhaps three) generations a year throughout its range. It occasionally visits honeydew if available in its habitat, but has never been recorded as visiting flowers. The reader is referred to Evans (1948) for further details on the behavior of this species.

Distribution.—Although rather local in its occurrence, this species is exceedingly widely distributed, having been taken from Georgia, Texas, and California north to Yukon, Manitoba, and Maine.

Specimens seen: 413 (170 ♀♀, 243 ♂♂). The following are marginal records: MAINE: Hancock Co., 1 ♂, Northeast Harbor [MCZ]; VERMONT: 1 ♀ (no further data) [MCZ]; NEW YORK: Cayuga Co., 15 ♀♀, 82 ♂♂, No. Fairhaven, 5 June-1 Sept. [CU]; ONTARIO: 1 ♀, 1 ♂, Haileybury, 7 July [CNC]; MINNESOTA: St. Louis Co., 1 ♀, 12 Oct. [Minn.]; MANITOBA: 1 ♀, Cormorant Lake, 1 July [CNC]; ALBERTA: 1 ♀, Smoky River, Peace R. Dist., 15 Sept. [CNC]; YUKON: 2 ♀♀, Kluane, 28 July [CNC]; 2 ♀♀, 2 ♂♂, Snag, 24 July [CNC]; CALIFORNIA: Calaveras Co., 1 ♀, 1 ♂, Jenny Lind, 21 Oct. [CU]; ARIZONA: Cochise Co., 1 ♀, Huachuca Mts., 11 June [CAS]; NEW MEXICO: Colfax Co., 1 ♀, 1 ♂, Raton, 12 Aug. [HEE]; TEXAS: Jeff Davis Co., 29 ♀♀, 23 ♂♂, Limpia Canyon, 14-22 July [HEE, CU, ANSP]; Gillespie Co., 2 ♀♀, 8 mi. So. of Fredericksburg, 5 July [HEE]; MISSOURI: 1 ♀, St. Louis [USNM]; GEORGIA: Thomas Co., 4 ♀♀, Ochlochnee, July [EU].

4. **Anoplius (Anoplius) fulgidus** (Cresson)

(Pl. XVII, fig. 109; pl. XXII, fig. 168.)

Pompilus fulgidus Cresson, 1865, Proc. Ent. Soc. Phila., 4: 131. [Type: ♀; Cuba (no further data); A.N.S.P. no. 562.]—Cresson, 1867, Trans. Amer. Ent. Soc., 1: 94.—Cresson, 1869, Proc. Boston Acad. Nat. Hist., 12: 367. [Orizaba, Mexico.]—Cameron, 1893, Biol. Centr.-Amer., Hymen. II, p. 199.—Dalla Torre, 1897, Cat. Hymen., VIII, p. 289.

Pompilus aeneopurpureus Fox, 1891, Trans. Amer. Ent. Soc., 18: 339. [Type: ♀; Portland, Jamaica; A.N.S.P. no. 561.] New synonymy.—Dalla Torre, 1897, Cat. Hymen., VIII, p. 270. [Erroneously reported from Indiana.]

Anoplius (*Pompilinus*) *fulgidus* Viereck, 1906, Trans. Amer. Ent. Soc., 32: 232. [Williams, Ariz.]

Psammochares (*Anoplius*) *fulgidus* Banks, 1917, Bull. Mus. Comp. Zool., 61: 108. [Florida.]

Psammochares aeneopurpureus Gowdey, 1926, Jamaica Dept. Agri. Ent. Bull. 4, p. 96.

Anoplius fulgidus Bradley, 1946, Mem. Soc. Cubana Hist. Nat., 18: 129.

Anoplius aeneopurpureus Bradley, 1946, Mem. Soc. Cubana Hist. Nat., 18: 129.

Anoplius aenopurpureus [*sic*] Dreisbach, 1950, Amer. Midl. Nat., 43: 575, 582, 588, fig. 7.

This essentially tropical form crosses our borders rather sparingly. It may be easily told by the strongly metallic-blue coloration of the integument. Structurally it is very close to the other members of the *nigerrimus*-group, particularly to *virginiensis* Cresson.

FEMALE.—Length 10 (7.5-14) mm. Integument of fresh specimens brilliant deep metallic Prussian blue, fading to violet in older specimens. Wings fuliginous, somewhat darker along the outer margin, with a violet or somewhat brassy reflection. Pubescence very fine, brownish-violaceous, often conspicuously silvery on the lower front and sides of the clypeus, sometimes also more or less so on the pronotum and coxae. Clypeus, front, vertex, front coxae, thoracic dorsum, and propodeum all with considerable black erect hair; remaining coxae and sometimes the femora slightly hairy; first abdominal tergite with numerous fine hairs anteriorly; pygidium very densely bristly.

Clypeus about 2.5 times as broad as high, its apical margin truncate. Front narrow, the middle interocular distance varying from .52 to .54 times the transfacial distance. Inner orbits converging slightly above, the upper interocular distance from .8 to .9 the lower. Ocelli in a close triangle, the front angle of which is much less than a right angle; postocellar line less than the ocello-ocular line as 3 is to 4. Antennae elongate, the first four segments in a ratio of about 3:1:5:4, segment 3 equal to or greater than the upper interocular distance.

Pronotum short, its posterior margin angulate. Median line of propodeum weakly impressed. Front tarsus weakly spined, the basitarsus with the spines of the upper row of moderate length but slender, setiform, the spines of the lower row fairly strong, sometimes about as long as the width of the tarsus (Fig. 168). Fore wing with the second and third submarginal cells of about the same width, the second narrowed by about .2 above, the third narrowed by from .5 to .9 above.

MALE.—Length 8 (6.5-9.5) mm. Integument deep but rather brilliant bluish, violet, or greenish; hind wings lightly infuscated, the fore wings moderately infuscated, darker along the margin, reflecting violet, brassy, or a play of colors. Pubescence fusco-violaceous, conspicuously silvery on the lower front and sides of the clypeus, sometimes also on the coxae, pronotum, and propodeum. Head, thoracic dorsum, front coxae, and propodeum all with moderately abundant erect, black hairs. Abdominal sternites 3 and beyond with a variable amount of short, suberect pile, never abundant or long enough to form "brushes"; subgenital plate usually with considerable short erect hair on the disc and along the outer margin.

Clypeus about twice as broad as high; front of moderate breadth, the middle interocular distance about .58 times the transfacial; eyes diverging very slightly above. First four antennal segments in a ratio of about 3:1:3:3. Ocelli as in the female. Pronotum angulate behind; propodeum with the median line at most very weakly impressed. Tarsal characters as in *nigerrimus*. Venation about as in the female, the third submarginal cell usually subtriangular.

Abdomen subfusiform; venter slightly hairy, as described above, but without brushes. Sternite 6 with a rather deep, V-shaped emargination. Subgenital plate very broad, the apex broadly subtruncate or somewhat obtusely pointed, the disc nearly flat or somewhat folded along the median line; disc covered with short erect setae, the outer margin usually more or less fringed with setae. Genitalia as shown in Fig. 109, very similar to those of *virginiensis*. The digitus volsellaris varies considerably in breadth, the one figured representing about the maximum breadth; in some it is much more slender and more sparsely setose. The short series of males before me exhibits an unusual amount of variation in the subgenital plate and genitalia; I cannot, however, find any constant characters which will separate it into more than a single species.

Distribution.—This is a tropical species, ranging from the Greater Antilles and Central America north to Florida and to Texas, southern Utah, and southern California.

Specimens seen: 52 (23 ♀♀, 29 ♂♂), only 15 from the United States. United States records are as follows: FLORIDA: 1 ♂, Brighton, 7 Apr. [KVK]; Dade Co., 2 ♀♀, 1 ♂, Miami Beach [ANSP]; 1 ♀, 2 ♂♂, Biscayne Bay [ANSP, USNM]; 1 ♀, Royal Palm Park, May. [UK]; TEXAS: Kerr Co., 1 ♀, Kerrville, 19 June [USNM]; Jeff Davis Co., 1 ♀, Limpia Canyon, Davis Mts., 24 July, on flowers of *Baccharis glutinosus* [HEE]; Williamson Co., 1 ♀, Liberty Hill, Dec. [RWS]; ARIZONA: Coconino Co., 1 ♀, Bill Williams Fork [UK]; UTAH: Washington Co., 1 ♂, Leeds, 18 Sept. [UAC]; CALIFORNIA: Los Angeles Co., 1 ♀, Pasadena, Feb. [ANSP]; Riverside Co., 1 ♀, Palm Springs, 20 Apr. [CIS]. Specimens also seen from Mexico (Baja California, Nayarit, San Luis Potosi, Sonora, and Vera Cruz), Guatemala, Honduras, Panama, Jamaica, Cuba, Puerto Rico, and Haiti.

5. **Anoplius (Anoplius) virginiensis** (Cresson)

(Pl. XVII, fig. 108; pl. XXI, fig. 150; pl. XXII, fig. 170.)

Pompilus virginiensis Cresson, 1867, Trans. Amer. Ent. Soc., 1: 92. [Lectotype: ♂; Virginia (no further data); A.N.S.P. no. 555.]—Provancher, 1882, Nat. Canad., 13: 35, 37.—Dalla Torre, 1897, Cat. Hymen., VIII, p. 335.

Aphiloctenus virginiensis Ashmead, 1902, Canad. Ent., 34: 87. [Selected genotype of new genus *Aphiloctenus*.]

Anoplius virginiensis Smith, 1910, Ann. Rpt. N. J. State Mus. 1909, p. 674. —Procter, 1938, Biol. Survey Mt. Desert Reg., VI, Insecta, p. 430. [Mt. Desert, Me.]—Strickland, 1947, Canad. Ent., 79: 125. [Edmonton, Alta.]—Dreisbach, 1950, Amer. Midl. Nat., 43: 587-590, figs. 27 and 30.

Psammochares (*Anoplius*) *virginiensis* Banks, 1912, Jour. N. Y. Ent. Soc., 19: 224.—Banks, 1912, Ent. News, 23: 108.—Rohwer, 1916, Conn. Geol. Nat. Hist. Survey Bull. 22, p. 633. [Conn.]—Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 987.—Johnson, 1930, List Insect Fauna Nantucket, p. 111.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 128.—Brimley, 1938, Insects No. Carolina, p. 434.

Pompiloides cylindricus Blackman and Stage, 1924, N. Y. State Coll. Forestry, Syracuse, Tech. Publ. no. 17, p. 194. [Misidentification; bred from decaying hickory.]

The following combination of characters will separate *virginiensis* from the several species which closely resemble it: (1) the front basitarsus of the female is weakly spined, the spines of the upper row being very small (Fig. 170); (2) the front and vertex of the female are very narrow, and the third antennal segment nearly equal to the upper interocular distance; (3) the abdomen of the male is very slender basally, is more or less annulated by bands of fine silvery pubescence, and possesses a short, loose brush of erect setae on sternites 2 to 6, strongest on 4 and 5 (Fig. 150); (4) the male subgenital plate is slender and acute apically, though less attenuate than in the following species. This is a common pompilid throughout much of the northeastern United States and southern Canada.

FEMALE.—Length 10.5 (8-13.5) mm. Color black; wings subhyaline, becoming gradually slightly more infuscated apically, the outer margins with a distinct fuscous band. Pubescence very fine, brownish, usually silvery on the middle and hind coxae above, occasionally silvery on the lower front and sides of the clypeus, sometimes also on the thoracic pleura and the bases of the basal abdominal tergites. Clypeus, front, vertex, temples, propleura, and front coxae with numerous dark erect hairs; propodeum rather strongly hairy; thoracic dorsum with scattered hairs; venter with a few setae; pygidium densely bristly.

Clypeus 2.2 to 2.5 times as broad as high, the apical margin slightly concave. Front rather narrow, the middle interocular distance varying from .53 to .58 times the transfacial distance (commonly about .55). Eyes converging slightly above, the upper interocular distance about .85 the lower. Ocelli in a close triangle, the front angle acute; postocellar line less than the ocello-ocular as 4 is to 5. Antennae elongate, the first four segments in a ratio of about 3:1:5:3.5, segment 3 subequal to the upper interocular distance (.9 to 1.2 times it). Temples narrow; vertex not at all elevated above the eye-tops.

Pronotum distinctly angulate behind. Slope of the propodeum low and even; median line weakly impressed if at all. Front basitarsus (Fig. 170) very weakly spined, the spines of the upper row very short, often seen with difficulty, those of the lower row moderately strong, one or two of them sometimes as long as the width of the tarsus. Fore wing with the second and third submarginal cells both 4-sided, both usually a little broader than high, of about equal breadth, the second narrowed by from .2 to .5 above, the third narrowed by from .5 to .9 above.

MALE.—Length 8.5 (6.5-11) mm. Color black; wings hyaline, the outer margin of the fore wings and apex of the hind wings with a conspicuous fuscous band. Head and thorax in large part silvery-sericeous, including the scape and the coxae, and to some extent the femora and tibiae; propodeum usually wholly silvery; first abdominal tergite with a broad basal silvery band, second and third tergites with progressively narrower silvery bands. Clypeus, front, and vertex with numerous dark hairs; front coxae, pro- and mesonota, and scutellum usually slightly hairy; propodeum with numerous fine, rather pale hairs on the sides; abdominal venter beyond the base of the second sternite with considerable short, dark, suberect hair, densest on sternites 4 and 5, where it tends to form loose brushes (Fig. 150).

Clypeus slightly over twice as broad as high, truncate below. Front of moderate breadth; inner orbits subparallel or diverging very slightly above. Ocelli as in the female. First four antennal segments in a ratio of about 3:1:3:3, the first three together equalling about 1.2 times the upper interocular distance. Pronotum sharply angled behind. Slope of the propodeum very low; median line often well impressed. Last segment of front tarsus modified as in *nigerrimus*. Venation as in the female; basal and transverse median veins of the fore wing sometimes interstitial.

Abdomen (Fig. 150) rather slender, especially basally, not attaining its full diameter until the end of the second segment; first tergite sloping only very slightly in profile. Venter with a considerable amount of short, bristly hair, as described above. Sternite 6 with the emargination broadly U-shaped. Subgenital plate slender, the sides approaching evenly to a narrowly rounded apex, the median line somewhat raised; disc rather hirsute, especially apically. Genitalia (Fig. 108) with the parameres slender, straight, the outer part with sparse long setae; basis volsellaris with a single long seta; digiti slender, the apex accuminate, the disc clothed with erect setae of moderate length, all of which are straight; parapenial lobes simple, slightly curved; aedoeagus of moderate breadth, the apex feebly bilobed.

Biology.—The typical habitat of this species is on the ground or low foliage in sunny spots in woodlands. In the northern parts of the range there is one yearly generation, in early summer, although females may occasionally be found as late as September. Farther south there are two distinct generations, one in spring and one in late summer. Flowers are occasionally visited, particularly in the vicinity of woods, and the species has been taken on *Ceanothus, Solidago,* and *Pastinaca.* Nothing is known of the prey or nesting habits of this species. I have seen females walk under loose bark of trees, possibly looking for a convenient niche to serve as a nest. Blackman and Stage (1924) have reared it from dead hickory.

Distribution.—This species occurs transcontinentally, chiefly in the Transition Zone, from Nova Scotia, Manitoba, and British Columbia south to Washington, Colorado, Missouri, and Georgia.

Specimens seen: 590 (262 ♀♀, 328 ♂♂). The following records are marginal: NOVA SCOTIA: 1 ♀, Kentville, 13 July [CNC]; NEW BRUNSWICK: 1 ♂, Nerepis [USNM]; QUEBEC: 1 ♀, 1 ♂, Hemmingford, 5 July [CNC]; ONTARIO: 3 ♀♀, 11 ♂♂, Ottawa, July-Aug. [CNC]; 1 ♂, Gravenhurst, 6 July [AMNH]; MICHIGAN: Baraga Co., 1 ♂, Pequaming, 14 July [ANSP]; MINNESOTA: Lake of the Woods Co., 1 ♀, Baudette, 10 Aug. [Minn.]; MANITOBA: 1 ♂, Emerson, 15 July [CNC]; ALBERTA: 2 ♂♂, Wabamun, June-July [Alta.]; BRITISH COLUMBIA: 9 ♂♂, Steelhead, 9-31 Aug. [CNC]; WASHINGTON: 1 ♀ (no further data) [CU]; COLORADO: 1 ♂ (no further data) [USNM]; KANSAS: Riley Co., 6 ♀♀, 3 ♂♂, Manhattan, May, Oct. [KSC]; MISSOURI: Taney Co., 1 ♂, Hollister, 12 Aug. [CU]; KENTUCKY: Harlan Co., 2 ♀♀, Pine Mt., 3 May [ANSP]; GEORGIA: Fulton Co., 1 ♂, Atlanta, 5 May [EU]; Charlton Co., 1 ♀, Okefenokee Swamp, June [CU].

6. **Anoplius (Anoplius) hispidulus** Dreisbach
(Pl. XVII, fig. 110; pl. XX, fig. 138; pl. XXI, fig. 149; pl. XXII, fig. 159.)

Anoplius hispidulus Dreisbach, 1950, Amer. Midl. Nat., 43: 577, 585, figs. 25 and 26. [Type: ♂; Algonquin, Ill., 10 Aug. 1895; Ill. Nat. Hist. Survey (not seen by present author).]

This apparently uncommon species is best recognized by the very narrow, somewhat emarginate clypeus of the female, and the characteristic male genitalia and subgenital plate; the third submarginal cell is triangular and often petiolate.

FEMALE.—Length 8 (7-9) mm. Color black; wings subhyaline, outer margin of the fore wing and apex of the hind wing with a fuscous band. Pubescence brownish-cinereous, shading into silvery on the middle and hind coxae above. Front and vertex sparsely hairy; front coxae, pronotum, mesonotum, and scutellum with scattered hairs; propodeum rather hairy, especially on the sides; middle and hind coxae and first abdominal tergite usually slightly hairy.

Clypeus only a little more than twice as broad as high, its apical margin shallowly but noticeably emarginate. Front rather broad, the middle interocular distance varying from .58 to .60 times the transfacial distance; upper interocular distance very slightly shorter than the lower. Vertex broad, straight across above the eye-tops. Ocelli close together, forming an acute angle in front; postocellar line: ocello-ocular line about as 2:3. First four antennal segments in a ratio of about 5:2:8:7, segment 3 equal to from .65 to .80 times the upper interocular distance. (Head shown in Fig. 159.)

Pronotum distinctly angulate behind. Slope of the propodeum low and even; median line faintly impressed above. Front basitarsus weakly spined, the spines of the upper row (except the apical one) extremely minute, those of the lower row only about half as long as the width of the tarsus. Fore wing with the stigma short; marginal cell approximately its own length from the wing-tip; second and third submarginal cells both usually somewhat broader than high, the second quadrate, the third triangular, often petiolate.

MALE.—Length 7 (6-8) mm. Color black; wings nearly hyaline, the outer margins with a brownish band. Pubescence more or less brownish, silvery as follows: lower front, coxae, lower pleura, propodeum, and basal bands on the first two or three abdominal tergites. Front, vertex, pronotum, front coxae, and propodeum with sparse erect hairs; third abdominal sternite with numerous short, suberect setae, more abundant caudad; fourth and fifth sternites each with a rather dense brush of short setae; last two sternites somewhat hirsute (Fig. 149).

Clypeus about twice as broad as high, its apical margin slightly arcuately concave. Front rather broad, the middle interocular distance about .62 times the transfacial. Inner orbits diverging very slightly above. Ocelli about as in the female. First four antennal segments in a ratio of about 11:5:12:12, segment 3 from 2.5 to 3 times as long as its greatest thickness. Pronotum angulate behind; propodeum sloping very gradually and evenly. Last segment of front tarsus feebly produced on the inner margin. Wing venation as in the female; third submarginal cell triangular, often petiolate.

Abdomen (Fig. 149) subfusiform, the first segment rather slender. Sternites with short brushes of hair as described above and shown in the figure. Sternite 6 with a rather deep V-shaped emargination. Subgenital plate (Fig. 138) rather broad within, tapering apically to a very slender, acute point, the extreme tip very narrowly rounded. Genitalia (Fig. 110) differing notably from other members of the subgenus by virtue of the very long parameres, which much exceed the other appendages; there is a strong sub-basal squama, and the outer margin is strongly setose. The volsellar digitus is very slender, the disc provided with a number of moderately long, recurved hairs; the apex is bare and acute. Parapenial lobes slender, simple, slightly exceeded by the aedoeagus, which is broadest about two-thirds of the way out, the apex deeply cleft.

Biology.—I have collected this species in series on the flowers of parsnip, *Pastinaca sativa,* and taken a few specimens on sand nearby.

Distribution.—This species is known from only five localities, in the states of Illinois, Michigan, New York, Connecticut, and Maryland.

Specimens seen: 16 (8 ♀♀, 8 ♂♂). CONNECTICUT: Hartford Co., 7 ♀♀, 7 ♂♂, East Hartford, 11-20 June (H. E. Evans) [HEE, ANSP, USNM]; NEW YORK: Orange Co. 1 ♂, Tuxedo, 24 June (L. L. Pechuman) [KVK]; MARYLAND: Kent Co., 1 ♀, Chestertown, 27 Aug. [ANSP]; MICHIGAN: (Oscoda Co., 10 June; recorded by Dreisbach, 1950); ILLINOIS: (McHenry Co., Algonquin, 10 Aug.; recorded by Dreisbach, 1950).

7. **Anoplius (Anoplius) basalis** Dreisbach

(Pl. XVII, fig. 111; pl. XX, fig. 139; pl. XXI, fig. 148; pl. XXII, fig. 160.)

Anoplius basalis Dreisbach, 1950, Amer. Midl. Nat., 43: 575, 578, 589, figs. 9 and 10. [Type: ♂; Rutland, Vt., 15 Aug. 1916 (Chittenden); M.C.Z. no. 28,388.]

This species appears to be somewhat annectant between the *Nigerrimus* and *Illinoensis* species-groups. The female closely resembles *nigerrimus,* but differs in the much more hairy head, thorax, and propodeum; from *virginiensis* it differs principally in the broader front and vertex. The male resembles *illinoensis* and *ventralis* in most of its characteristics, but is much more extensively silvery-sericeous, and the genitalia are very distinctive.

FEMALE.—Length 9.5 (8-11) mm. Color black; wings lightly infuscated, the fore wings darker along the margin, very slightly violaceous. Pubescence conspicuously silvery at least on the hind coxae above, often much more extensively so. Clypeus, front, vertex, occiput, front coxae, thoracic dorsum, and propodeum all with moderately abundant erect hairs; middle and hind coxae often somewhat hairy, the femora often slightly so.

Clypeus nearly three times as broad as high, the apical margin slightly concave. Front broad, the middle interocular distance about .6 the transfacial. Eyes converging noticeably above, the upper interocular distance about .85 times the lower. Ocelli forming an acute angle in front; postocellar line usually slightly shorter than the ocello-ocular line. Antennae of moderate length, the first four segments in a ratio of about 15:5:21:19, segment 3 varying from .75 to .9 times the upper interocular distance. (Head shown in Fig. 160.)

Pronotum sharply angulate behind. Slope of the propodeum low and even, the median line weakly impressed. Front basitarsus weakly spined, the spines of the upper row (except the apical one) short and slender, setiform, those of the lower row stout but very short. Fore wing with the marginal cell slightly more than its own length from the wing-tip; second submarginal cell rhomboidal, broader than high; third submarginal cell varying from triangular to fairly wide above.

MALE.—Length 8 (6-9.5) mm. Color black; wings nearly hyaline, with a darker marginal band. Pubescence silvery on the sides of the clypeus, lower front, coxae, lower pleura, and often the propodeum and basal bands on the basal abdominal tergites. Clypeus, front, vertex, front coxae, thoracic dorsum, and propodeum with moderately abundant erect hair; middle and hind coxae and first abdominal tergite slightly hairy; abdominal venter (Fig. 148) with moderately strong brushes of hair, that of the fourth sternite strongest, that of the fifth slightly less well developed, that of the third sternite weak.

Clypeus about 2.2 times as broad as high, its apical margin slightly concave; front broad, the middle interocular distance about .64 times the transfacial distance; inner orbits diverging very slightly above. Ocelli forming an acute angle in front; postocellar line: ocello-ocular line about as 2:3. Antennae rather long and slender, the first 4 segments in a ratio of about 3:1:3:3. Pronotum sharply angulate behind. Last segment of front tarsus rather strongly produced on the inner margin (much as in *ventralis*, shown in Fig. 164). Venation like that of the female.

Abdomen subfusiform, less slender basally than in the preceding two species. Venter with brushes of hair as described above and shown in Fig. 148. Sternite 6 with a rather deep V-shaped emargination. Subgenital plate (Fig. 139) much narrowed and attenuate apically, the extreme apex somewhat truncate. (In life the subgenital plate is somewhat folded medially, and therefore appears narrower apically than shown in the figure, where it is flattened out.) Genitalia (Fig. 111) with the parameres very stout basally, much more slender on the apical half; in dorsal view the base shows an arcuate constriction on the outer margin. Volsellar digitus straight for its basal half and folded upon itself, forming a double rod; the apical half is simple and irregularly acuminate, at an angle of about 120° to the basal half; at the outer angles are a number of setae which are abruptly bent upward about midway of their length. Parapenials simple, slightly exceeded by the aedoeagus.

Distribution.—This apparently uncommon species occurs transcontinentally in the Canadian zone, south to New Brunswick, Vermont, Manitoba, and at high altitudes to New Mexico and California.

Specimens seen: 15 (8 ♀♀, 7 ♂♂). NEW BRUNSWICK: (1 ♂, Nerepis, 20 Aug.) (recorded by Dreisbach, 1950);[18] VERMONT: 1 ♂, Rutland, 1-15

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[18] This is the specimen stated by Dreisbach (1950, p. 578) to be from "Nerepsis, Nebr., VIII-20-? A. G. Levitt". There is no such locality in Nebraska, and it is very doubtful if this species occurs in that state in any case. There is, however, a considerable amount of material in the U.S.N.M. collected by A. G. Leavitt at Nerepis, New Brunswick, and I have no doubt this specimen is from that source.

Aug. 1916 (Chittenden) [MCZ]; MANITOBA: 1 ♀, Herchner, 1 July 1949 (J. B. Wallis) [CNC]; NORTHWEST TERRITORIES: 1 ♀, 1 ♂, Norman Wells, 20-29 July 1949 (W. R. M. Mason) [CNC]; BRITISH COLUMBIA: 1 ♀, 1 ♂, Kaslo (J. M. Cockle) [CNC]; WASHINGTON: Pierce Co., 1 ♀, 3 ♂♂, Paradise Valley, Mt. Rainier, 21 July-3 Aug. (C. L. Fox, E. C. VanDyke) [CAS]; OREGON: Harney Co., 1 ♀, Fish Lake, Steens Mts., 7000 feet, 11 July 1927 (H. A. Scullen) [OSC]; CALIFORNIA: Fresno Co., 1 ♀, 60 Lake Basin, 10500 feet, 21 July 1910 (E. C. VanDyke) [CAS]; COLORADO: 1 ♀, Twin Sisters Mt., June (Cockerell) [USNM]; NEW MEXICO: Otero Co., 1 ♀, Cloudcroft, 9000 feet, on forest floor, 26 July 1948 (H. E. Evans) [HEE]; San Miguel Co., 1 ♂, Beulah, 29 June 1902 [ANSP].

Illinoensis Species-group

In this group the silvery pubescence, if present at all, is confined to the front and clypeus in both sexes. The front basitarsus of the female is rather strongly spined; the last segment of the front tarsus of the male is strongly produced on the inner margin, the inner claw strongly curved, deeply cleft, the inner ray acute. The male venter has prominent brushes of long hairs.

8. **Anoplius (Anoplius) imbellis** Banks

(Pl. XVII, fig. 112; pl. XX, fig. 142; pl. XXII, fig. 167.)

Anoplius imbellis Banks, 1944, Bull. Mus. Comp. Zool., 94: 169. [Type: ♀; Corvallis, Ore. (H. A. Scullen); C. A. S. no. 5954.]—Strickland, 1947, Canad. Ent., 79: 125. [Medicine Hat, Alta.]—Dreisbach, 1950, Amer. Midl. Nat., 43: 583, 585, 590, figs. 20 and 24.

Anoplius imbellis var. *major* Dreisbach, 1950, Amer. Midl. Nat., 43: 581-582, 590. [Type: ♂; Falls Church, Va., 29 June (N. Banks); M.C.Z. no. 28,389.] New synonymy.

This very small species has only recently been recognized; it is, however, very widely distributed and, at least in the Pacific states, not uncommon. The male is easily recognized by the characteristic subgenital plate (Fig. 142) and genitalia (Fig. 112). The female is extremely similar to *illinoensis* and *ventralis,* but is smaller, and the eyes are not or barely convergent above. This sex also resembles *nigerrimus* in some respects, but the front tarsi are more spinose and the coxae never silvery-sericeous.

FEMALE.—Length 7.5 (5-10) mm. Color black; front wings lightly to moderately infuscated, with a darker marginal band, hind wings subhyaline or lightly infuscated, darker apically. Pubescence brownish-fuscous, obscurely violaceous, sometimes silvery on the sides of the lower front and clypeus and base of the mandibles. Body with a variable amount of erect hair; clypeus, front, vertex, temples, propleura, front coxae, thoracic dorsum, and propodeum slightly to moderately hairy; mesopleura and middle and hind coxae often somewhat hairy.

Clypeus about 2.5 times as broad as high, the apical margin truncate. Front of moderate, rather variable breadth, the middle interocular distance from .53 to .61 times the transfacial. Inner orbits a little emarginate in the middle, barely if at all convergent above, the upper interocular distance varying from .9 to 1.05 times the lower. Antennae not especially long, the first four segments in a ratio of about 30:10:40:33, segment 3 equal to from .65 to .85 times the upper interocular distance. Ocelli forming a right or acute angle in front, the postocellar line subequal to or slightly less than the ocello-ocular.

Posterior pronotal margin angulate. Propodeum usually with a slight median impression; slope low, a little steeper behind, with a poorly defined slightly concave declivity. Front basitarsus (Fig. 167) with the spines of the upper row large enough to be readily seen, and usually about half as long as the width of the tarsus, those of the lower row, in part at least, as long as the width of the tarsus. Fore wing with the stigma small; marginal cell about or slightly more than its length from the wing-tip; second and third submarginal cells both somewhat broader than high; third submarginal narrowed by at least half above, sometimes nearly or quite triangular; third transverse cubital vein strongly arched.

MALE.—Length 7 (5-9) mm. Color black; wings subhyaline or lightly infuscated, with a slightly darker marginal band. Pubescence brownish, often silvery on the lower front and clypeus. Front and vertex with numerous erect hairs; front coxae, thoracic dorsum, and propodeum a little hairy; abdominal sternite 3 with a few long erect hairs, sternites 4 and 5 each with a rather dense brush of prominent erect hairs, which are somewhat sinuate apically, and much shorter medially than laterally.

Clypeus about 2.2 times as broad as high. Front of moderate breadth, the middle interocular distance varying from .57 to .61 times the transfacial. Inner orbits slightly divergent above, the upper interocular distance varying from 1.0 to 1.1 times the lower. Ocelli as in the female. First four antennal segments in a ratio of usually about 25:10:28:27, segment 3 from 2.5 to 3 times as long as thick. Pronotum angulate behind. Slope of the propodeum low; median line impressed or not. Last segment of front tarsus strongly lobed on the inner margin, as in other members of this species-group. Venation as in the female; third submarginal cell often triangular, rarely petiolate.

Abdomen with prominent ventral hair-tufts, as described above. Sternite 6 with a large, broadly U-shaped emargination. Subgenital plate (Fig. 142) raised but slightly along the median line, the sides tapering to a narrowly rounded apex; the disc is inconspicuously setose, the outer margin fringed with a rather even row of stiff bristles. This is in contrast to the much more keeled, rather bushy-haired subgenital plates of the two species which follow. Genitalia (Fig. 112) with the parameres short, straight, the squamae prominent and with a number of setae, the outer margin and apex with sparse long setae. Volsellar basis with only a few tiny setae; digitus broadened and slightly curved beyond the basal half, the apex somewhat attenuate, the disc evenly clothed with short setae. Aedoeagus weakly bilobed apically, exceeding slightly the other appendages, supported by the simple, slightly curved parapenial lobes.

Biology.—I have taken this species along streams in much the same habitat as *A.* (*A.*) *ithaca;* it does not, however, appear to be restricted to this habitat. Males have been taken on the flowers of *Heracleum* and *Eryngium* (Umbelliferae), and females on *Solidago* (Compositae); both sexes occasionally visit honeydew.

Distribution.—This species occurs transcontinentally from the Hudsonian to the Upper Austral Zones, but appears to be most common in the Transition Zone. It appears to be considerably more common in the Pacific states and provinces than elsewhere.

Specimens seen: 220 (78 ♀♀, 142 ♂♂). The following records appear to define the limits of the range as far as present knowledge indicates: MASSACHUSETTS: Suffolk Co., 1 ♂, Forest Hills, 15 Aug. [CAS]; Franklin Co., 1 ♀, Buckland, Sept. [MCZ]; NEW YORK: Oswego Co., 1 ♀, 28 Aug. [KVK]; Erie Co., 1 ♂, Buffalo, 16 Aug. [KVK]; MANITOBA: 1 ♂, Winnipeg, July [CNC]; 1 ♀, The Pas, 11 Aug. [Minn.]; NORTHWEST TERR.: 11 ♀♀, 22 ♂♂, Norman Wells, 12 July-3 Aug. [CNC]; YUKON: 3 ♂♂, Whitehorse, 9-11 July [CNC]; 1 ♀, 2 ♂♂, Snag, 24 July [CNC]; BRITISH COLUMBIA: Vancouver Isl., 1 ♀, Nanaimo, 25 June [CAS]; CALIFORNIA: San Diego Co., 1 ♂, Lakeside, 8 May [CU]; Riverside Co., 1 ♀, Ripley, 19 Aug. [CIS]; UTAH: Washington Co., 1 ♂, Leeds, 25 Apr. [UAC]; NEW MEXICO: San Miguel Co., 1 ♂, Beulah, 24 July [USNM]; TEXAS: Jeff Davis Co., 1 ♀, 2 ♂♂, Limpia Canyon, 5000 feet, 22-24 July [HEE]; KANSAS: Riley Co., 3 ♂♂, 22 May, 2-16 Oct. [HEE, KSC]; Douglas Co., 1 ♂, Baldwin [USNM]; TENNESSEE: Great Smoky Mts. Nat. Park, 1 ♀, 1 ♂, Clingman's Dome, 6300-6600 ft., 5 Aug. [ANSP]; NORTH CAROLINA: Buncombe Co., 2 ♀♀, Asheville, Aug. [HEE]; VIRGINIA: Fairfax Co., 1 ♀, 4 ♂♂, Dunn Loring, 30 May, 14 June, 5 Sept. [KVK].

9. **Anoplius (Anoplius) illinoensis** (Robertson)

(Pl. XVII, fig. 113; pl. XX, figs. 143, 145; pl. XXI, fig. 154; pl. XXII, fig. 166.)

Pompilus luctuosus Provancher, 1882, Nat. Canad., 13: 35, 36. [*Nec* Cresson, 1865; misidentification.]—Provancher, 1889, Faune Ent. Canad., Hymen., Add. & Corr., p. 260.

Pompilus illinoensis Robertson, 1901, Trans. Amer. Ent. Soc., 27: 202. [Lectotype: ♀; Carlinville, Ill. (Robertson); A.N.S.P.][19]

Anoplius luctuosus Smith, 1910, Ann. Rpt. N. J. State Mus. 1909, p. 674. [N. J.]

Psammochares (*Anoplius*) *illinoisensis* [*sic*] Banks, 1912, Jour. N. Y. Ent. Soc., 19: 224.

Psammochares (*Psammochares*) *luctuosus* Rohwer, 1916, Conn. Geol. Nat. Hist. Survey Bull. 22, p. 633. [Conn.]

Psammochares (*Anoplius*) *illinoensis* Banks, 1917, Bull. Mus. Comp. Zool., 61: 108.—Brimley, 1938, Insects No. Carolina, p. 434. [N. C.]

Psammochares (*Anoplius*) *illinoiensis* [*sic*] Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 987. [N. Y.]—Johnson, 1930, List Ins. Fauna Nantucket, p. 111.—Brimley, 1936, Jour. Elisha Mitchell Sci. Soc., 52: 128.

Psammochares (*Anoplius*) *luctuosus* Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 987.

Anoplius illinoensis Dreisbach, 1950, Amer. Midl. Nat., 43: 583, 585, 590, figs. 19 and 23.

One of the commoner elements in the pompilid-fauna of the northeastern and north central United States, *illinoensis* may be told from related species by the strongly spinose anterior basitarsus of the female (Fig. 166), the absence of more than a few inconspicuous hairs on the propodeum of the male, and the very characteristic male genitalia (Fig. 113).

FEMALE.—Length 12 (9-16) mm. Color black; wings lightly to moderately infuscated, the outer margins with a darker fuscous band. Pubescence brownish-fuscous, on the abdomen obscurely violaceous. Front, vertex, pronotum, and propodeum with scattered erect hairs; mesonotum, scutellum, coxae, and first abdominal tergite also somewhat hairy; mesopleura without erect hairs.

Clypeus about 2.5 times as broad as high, the apical margin truncate or a little concave. Front of moderate breadth, the middle interocular distance varying from .52 to .58 times the transfacial distance. Inner orbits emarginate near the middle, slightly convergent above, the upper interocular distance about .9 the lower. Ocelli forming a right or acute angle in front; postocellar line usually slightly less than the ocello-ocular. First four antennal segments in a ratio of about 30:10:50:35, segment 3 equal to from .8 to 1.0 times the upper interocular distance.

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[19] Robertson described this species from four co-types, two each in the ANSP and USNM, all conspecific beyond a doubt. The female in the former collection is hereby designated the type.

Pronotum angulate behind. Propodeum slightly more declivous behind, with a moderately well-defined declivity; median line impressed or not. Front basitarsus (Fig. 166) strongly spined, more so than other members of the species-group, the spines of both rows for the most part as long as the width of the tarsus. Fore wing with the stigma short; marginal cell long, about or slightly more than its own length from the wing-tip; second and third submarginal cells of about the same width, both slightly broader than high; third submarginal cell narrowed by more than half above (Fig. 154).

MALE.—Length 9.5 (7-12.5) mm. Color black; wings hyaline or lightly infuscated, the outer margins with a fuscous band. Pubescence brownish or nearly black, obscurely violaceous, nowhere silvery. Clypeus, front, vertex, pronotum, and front coxae with a few erect hairs; propodeum without more than a few thin hairs on the sides; third abdominal sternite sometimes slightly hairy, but without a definite brush; fourth and fifth sternites with brushes of rather long hairs, longer on the sides than medially, the hairs sinuate at their tips for the most part; sternite 6 with some short bristles on each side; subgenital plate somewhat bushy-haired.

Mandibles bidentate. Clypeus a little more than twice as broad as high. Front of moderate breadth, the middle interocular distance varying from .56 to .61 times the transfacial. Inner orbits subparallel, slightly emarginate near the middle. Vertex rather broad, raised slightly above the eye-tops; ocelli as in the female. Antennae elongate, the first four segments in a ratio of about 25:10:32:30, segment 3 nearly 4 times as long as thick. Pronotum angulate behind. Last segment of front tarsus strongly produced on the inner margin, this segment about 1.7 times as long as its greatest width. Venation like that of the female; third submarginal cell often nearly or quite triangular.

Abdomen relatively stout; venter with brushes of hair as described above. Sternite 6 with the emargination large, V-shaped. Subgenital plate (Fig. 143) rather narrow, the apex attenuate, narrowly rounded, the median line strongly elevated; apical portion more or less bushy-haired. The plate is slightly more long and narrow than in *ventralis*, and is wholly pigmented, though when not exserted it appears very similar. Genitalia (Fig. 113) characterized at once by the peculiar form of the digiti; these are somewhat triangular in shape, the apex acuminate, the upper outer margin slightly concave, the upper inner margin slightly convex; the disc is clothed with short, straight hairs which are rather long and dense along the upper inner margin and directed inward. The other appendages do not differ notably from those of related species.

Biology.—This species is chiefly characteristic of open fields and meadows. Nothing whatever is known of its nesting habits. I have taken it on the flowers of *Pastinaca sativa, Daucus carota, Eupatorium perfoliatum, Hymenopappus corymbosus, Solidago* spp., *Tamarix gallica,* and *Melilotus alba.* It is on the wing from June to September.

Distribution.—This species is chiefly an inhabitant of the Alleghanian and Carolinian faunas, occurring from Quebec, Michigan, and Montana to Colorado, Texas, and Georgia.

Specimens seen: 409 (290 ♀♀, 119 ♂♂). The following records are marginal: Maine: Kennebec Co., 1 ♀, Winthrop, Aug. [MCZ]; Quebec: 1 ♂, Hemmingford, 24 June [CNC]; Ontario: 3 ♀♀, Ottawa [CNC]; Michigan: Cheboygan Co., 1 ♀, Mullet Lake, 10 Aug. [Minn.]; Minnesota: Clearwater Co., 2 ♀♀, 1 ♂, Itasca, July-Aug. [Minn.]; North Dakota: Cass Co., 1 ♀, Fargo, Aug. [MCZ]; South Dakota: Custer Co., 8 ♀♀, 1 ♂, Black Hills, 24 Aug. [HEE]; Montana: 1 ♂ (no further data) [ANSP]; Colorado: Boulder Co., 1 ♀, July [USNM]; Kansas: Reno Co., 1 ♀, 11 June [KSC]; Texas: Dallas Co., 1 ♀, Dallas, June [USNM]; Missouri: Taney Co., 1 ♀, Ozark Lake, 21 Sept. [CAS]; Georgia: Spalding Co., 1 ♀, Pomona, 15 May [CU].

10a. **Anoplius (Anoplius) ventralis ventralis** (Banks)

(Pl. XVIII, fig. 114; pl. XX, fig. 141; pl. XXI, fig. 147; pl. XXII, fig. 164.)

Psammochares ventralis Banks, 1910, Jour. N. Y. Ent. Soc., 18: 120. [Type: ♂; Falls Church, Va., 22 Oct. (N. Banks); M.C.Z. no. 13,698.]—Leonard, 1926, Cornell Agri. Exp. Sta. Memoir 101, p. 986. [Ithaca, N. Y.]

Anoplius ventralis Procter, 1938, Biol. Survey Mt. Desert Reg., VI, Insecta, p. 430. [Mt. Desert, Me.]—Dreisbach, 1950, Amer. Midl. Nat., 43: 586-588, figs. 29 and 32.—Krombein, 1950, Jour. Elisha Mitchell Sci. Soc., 65: 264. [Dare Co., N. C.]

Anoplius elongatus Dreisbach, 1950, Amer. Midl. Nat., 43: 575-576, figs. 11 and 12. [Type: ♂; Pelican Lake, Nisswa, Minn., 30 July 1919 (L. Brunner); Univ. Nebraska.][20] New synonymy.

Anoplius subtarsatus Dreisbach, 1950, Amer. Midl. Nat., 43: 578-579, 585, figs. 18 and 22. [Type: ♂; Raleigh, N. C., 9 May 1940 (D. L. Wray); N. Carolina Dept. Agri.][20] New synonymy.

This species resembles very closely the preceding, and the nominate subspecies occurs over much the same range, though it extends farther south. Both sexes show a greater amount of hair on the body, as expressed in the keys; the front basitarsus of the female is somewhat less strongly spined than in *illinoensis;* the male genitalia and subgenital plate show minor though constant differences from this species.

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[20] The type specimens of *elongatus* and *subtarsatus* are, at this writing, still in the hands of the describer, and I have not seen them. Judging from the descriptions and figures, both appear to fall within the range of variation of *ventralis ventralis* as here interpreted.

FEMALE.—Length 12 (10-15) mm. Color black; fore wings lightly to moderately infuscated, with a darker marginal band, sometimes slightly violaceous; hind wings subhyaline basally, the apex infuscated. Pubescence very dark, fusco-violaceous, obscurely reflecting deep bluish, especially on the abdomen. Front and vertex with numerous erect hairs; front coxae rather hairy, the middle and hind coxae usually slightly so; pronotum, mesonotum, scutellum, and mesopleura all with at least a few rather long hairs; propodeum with abundant hairs.

Clypeus about 2.5 times as broad as high, its apical margin slightly concave. Front of moderate breadth, the middle interocular distance varying from .54 to .59 times the transfacial. Inner orbits slightly convergent above, the upper interocular distance about .9 the lower. Ocelli forming a right or acute angle in front, the postocellar line usually slightly less than the ocello-ocular. First four antennal segments in a ratio of about 3 : 1 : 5 : 4, segment 2 equal to from .8 to 1.0 times the upper interocular distance.

Posterior margin of pronotum angulate. Propodeum with a vaguely defined posterior declivity. Front basitarsus with the spines of the upper row of moderate size, generally about half as long as the diameter of the tarsus, those of the lower row in part at least as long as or longer than the diameter of the tarsus. (The illustration for *imbellis*, Fig. 167, serves equally well for this species.) Fore wing with the second submarginal cell usually not broader than high, because of the obliquity of the second transverse cubital vein; third submarginal wider than the second and usually wider than high, narrowed by from .6 to .9 above.

MALE.—Length 10 (7-14) mm. Color black; wings subhyaline to moderately infuscated, with a darker marginal band. Pubescence often a bit silvery on the sides of the lower front, otherwise very dark, somewhat violaceous, obscurely reflecting deep bluish. Scape, clypeus, front, vertex, temples, and propleura all with erect hairs; front coxae and pronotum somewhat hairy, the remainder of the thorax slightly so; propodeum strongly hairy; abdominal sternites 3, 4, and 5 each with a dense brush of rather long hairs, longer laterally than medially (the brush on the third sternite is often less strong than the others, and is rarely almost absent); sternites 6 and 7 somewhat hirsute. A lateral view of the propodeum and abdomen is shown in Fig. 147.

Mandibles bidentate. Clypeus slightly more than twice as broad as high. Middle interocular distance varying from .56 to .62 times the transfacial. Upper interocular distance subequal to or a little greater than the lower. Ocelli prominent, forming an angle in front which is generally slightly less than a right angle; postocellar line : ocello-ocular line about as 4 : 5. First four antennal segments in a ratio of roughly 30 : 10 : 32 : 31, segment 3 usually about 3 times as long as thick. Pronotum angulate behind. Propodeum with the slope low and even, the median line usually impressed. Last segment of front tarsus strongly produced on the inner margin (Fig. 164), as usual in this species-group. Venation about as in the female, the cells a bit further removed from the wing margin; the strongly oblique second transverse cubital vein is characteristic.

Abdominal venter with brushes of hair as described above and shown in Fig. 147. Sternite 6 with the emargination V-shaped. Subgenital plate (Fig. 141) of somewhat variable shape, but always with an elevated, pigmented, somewhat bushy-haired median band, and on either side more or less broad unpigmented areas. Genitalia (Fig. 114) also somewhat variable; parameres slender, not exceeding the aedoeagus, the squamae prominent and strongly setose; basis volsellaris with one or two setae of moderate length; digiti somewhat spindle-shaped, the apex acuminate, the disc clothed rather heavily with simple setae, except for a bare strip along the inner margin; parapenials curved slightly; aedoeagus rather broad, somewhat bilobed apically.

Biology.—This is a wide-ranging form which does not seem to be restricted to any particular habitat. I have taken it in sandy areas, fields, and wooded swampy areas. It has been taken on honeydew, and on the flowers of *Solidago* (Compositae), *Pastinaca,* and *Bifora* (Umbelliferae). Dates of capture vary from June to September in the northern parts of the range, February to November in the South.

Distribution.—This subspecies ranges throughout the Austroriparian, Carolinian, and Alleghanian faunas, from Florida and eastern Texas to Nova Scotia and Manitoba.

Specimens seen: 160 (90 ♀♀, 70 ♂♂). The following localities appear to be marginal: NOVA SCOTIA: 1 ♂, White Pt. Beach, Queens Co., 14 Aug. [CNC]; QUEBEC: 1 ♂, St. Hilaire, 11 July [CNC]; ONTARIO: 1 ♀, Merivale, 10 Sept. [CNC]; MICHIGAN: Cheboygan Co., 1 ♂, 4 July [UK]; MINNESOTA: Clearwater Co., 3 ♀♀, 1 ♂, Itasca Park, 3 July-10 Aug. [Minn.]; MANITOBA: 1 ♀, Winnipeg [CNC]; SOUTH DAKOTA: Pennington Co., 1 ♂, Hill City, 31 July [Minn.]; ARKANSAS: Prairie Co., 1 ♀, Hazen, 10 June [HEE]; TEXAS: Lee Co., 1 ♀, 1 ♂, Giddings, 6-10 July [HEE]; Victoria Co., 1 ♀, 2 ♂♂, Victoria, Mch., Nov. [USNM]; LOUISIANA: 1 ♀, New Orleans, 13 Mch. [USNM]; MISSISSIPPI: Harrison Co., 1 ♂, Biloxi, June [MCZ]; FLORIDA: Dade Co., 1 ♂, Paradise Key, 10 Mch. [USNM].

10b. **Anoplius (Anoplius) ventralis tarsatus** Banks
(Pl. XVIII, fig. 115.)

Anoplius tarsatus Banks, 1919, Bull. Mus. Comp. Zool., 63: 233, 234. [Type: ♀; Sherwood, Mendocino Co., Calif., 1 July 1907; C. U. no. 686.]—Strickland, 1947, Canad. Ent., 79: 125. [Medicine Hat, Alta.] —Dreisbach, 1950, Amer. Midl. Nat., 43: 585, 586, 590, figs. 17 and 21.

Psammochares luctuosus Williams, 1919, Bull. Hawaiian Sugar Pl. Assoc., Ent. Ser., no. 14, p. 110. [*Nec* Cresson, 1865; misidentification.] [Biology.]—Essig, 1926, Insects of Western North America, p. 882, fig. 742. [Biology.]—Essig, 1942, College Entomology, p. 697.

Anoplius luctuosus Williams, 1931, Handbook of Insects and Other Invert. of Hawaiian Sugar Cane Fields, pp. 240-241.

Anoplius papago Banks, 1941, Canad. Ent., 73: 120. [Type: ♂; Tucson, Ariz. (F. H. Snow); M.C.Z. no. 25,263.] New synonymy.—Dreisbach, 1950, Amer. Midl. Nat., 43: 584-585, 587, 590, figs. 28 and 31.

This conspicuously bluish wasp is a common element in the fauna of the western United States. It has also been introduced into the Hawaiian Islands, where it is the only representative of the family Pompilidae. Unfortunately it has usually been called *luctuosus*, but this is a very different insect belonging to the genus *Pompilus*.

FEMALE.—Length 11.5 (8.5-15) mm. Color black, rendered slightly to rather intensely bluish by the pubescence. In some individuals the pubescence is merely fusco-violaceous, rather obscurely reflecting bluish; on the other extreme are specimens in which the pubescence is wholly a rich Prussian blue. Fore wings lightly to rather heavily infuscated, with a darker marginal band, more or less violaceous; hind wings nearly hyaline basally, the apex infuscated. Scape usually hairy; entire head, thorax, and propodeum with moderately abundant erect black hairs; front coxae hairy, the middle and hind coxae and front femora somewhat so, sometimes also the remaining femora; first abdominal tergite with considerable erect hair anteriorly. Morphological features much as in *ventralis ventralis*. Front and vertex often a bit broader, the middle interocular distance varying from .53 to .61 times the transfacial distance; third antennal segment varying from .7 to 1.1 times the upper interocular distance.

MALE.—Length 9.5 (6.5-13.5) mm. Color black, rendered slightly to intensely bluish or blue-green by the pubescence; there is sometimes a patch of silvery pubescence on the sides of the lower front. Wings subhyaline to moderately infuscated, darker along the outer margin, more or less violaceous. Scape hairy below; front with abundant dark hairs; thorax and propodeum with considerable erect hair; venter with brushes of hair on sternites 3, 4, and 5, but that on 3 usually not as strong as the others and sometimes practically absent. Genitalia (Fig. 115) differing from those of the nominate subspecies in that the digiti are hairy along the inner margin as well as elsewhere, except at the extreme tip.

Biology.—Essig (1926) reports that this species nests in the ground and preys upon *Trochosa pratensis* (Emerton) (Lycosidae). Williams (1931) notes that the species first appeared in

Hawaii about 1910, and has since become common there. It may, he says, " often be seen dashing about the grass or low weeds ". He states that it preys on a variety of spiders. Earlier (1919) Williams notes that the species " though digging a separate burrow for each of her spiders, has a tendency to bury all these close together ".

This form is a not infrequent visitor to flowers, having been taken on *Asclepias, Heracleum lanatum,* and *Vicia.* In the northern parts of its range, it is on the wing chiefly from July to September; in the Sonoran parts of California there are records from every month of the year, suggesting a considerable number of generations a year in this area.

Distribution.—Lower Sonoran to Transition faunas, from western Texas, Chihuahua, and southern California to British Columbia and Alberta. As mentioned earlier, this form is now well established in the Hawaiian Islands.

Specimens seen: 287 (136 ♀♀, 151 ♂♂). The following records are marginal: BRITISH COLUMBIA: 1 ♀, Seton Lake, 4 Aug. [CNC]; 1 ♀, Creston, 12 Sept. [CNC]; ALBERTA: 1 ♀, Lethbridge, 21 Sept. [CNC]; 2 ♀♀, Medicine Hat, July-Aug. [Alta.]; MONTANA: Yellowstone Co., 1 ♀, Billings [USNM]; WYOMING: 1 ♂, Summit, 8835 feet, 16 Aug. [Minn.]; COLORADO: Boulder Co., 1 ♂, Boulder, July [MCZ]; El Paso Co., 1 ♀, Colorado Springs, Aug. [USNM]; NEW MEXICO: San Miguel Co., 1 ♂, Beulah, 24 July [ANSP]; TEXAS: Reeves Co., 1 ♀, Balmorhea Lake, 18 July [HEE]; Brewster Co., 1 ♀, Alpine, 1 July [OSC]; MEXICO: Chihuahua, 1 ♀, Madera, 6 July, 7200 feet [AMNH]; ARIZONA: Pima Co., 1 ♀, Baboquivari Mts. [USNM]; CALIFORNIA: San Diego Co., 1 ♀, Laguna Mt., 23 Aug. [CAS]; 1 ♂, Poway, 22 March [CAS]. I have also seen specimens from the islands of Hawaii, Maui, and Oahu in the Hawaiian Islands.

EXPLANATION OF FIGURES

Note: In all figures of male genitalia, the ventral aspect is shown on the left half, the dorsal on the right.

PLATE XI

Fig. 72.—*Anoplius* (*Lophopompilus*) *aethiops* (Cresson), male genitalia.
Fig. 73.—*A.* (*L.*) *cleora* (Banks), male genitalia.
Fig. 74.—*A.* (*L.*) *carolinus* (Banks), male genitalia.
Fig. 75.—*A.* (*L.*) *bengtssoni* (Regan), male genitalia.
Fig. 76.—*A.* (*L.*) *atrox* (Dahlbom), male genitalia.
Fig. 77.—*A.* (*Notiochares*) *amethystinus* (Fabricius), male genitalia.

PLATE XII

Fig. 78.—*A.* (*Anopliodes*) *bolli* Banks, male genitalia.
Fig. 79.—*A.* (*A.*) *parsonsi* (Banks), male genitalia.
Fig. 80.—*A.* (*Arachnophroctonus*) *bellicosus* (Banks), male genitalia.
Fig. 81.—*A.* (*A.*) *xerophilus* Evans, male genitalia.
Fig. 82.—*A.* (*A.*) *apiculatus* (Smith), male genitalia.
Fig. 83.—*A.* (*A.*) *semirufus* (Cresson), male genitalia.

PLATE XIII

Fig. 84.—*A.* (*A.*) *marginalis* (Banks), male genitalia.
Fig. 85.—*A.* (*A.*) *americanus* (Beauvois), male genitalia.
Fig. 86.—*A.* (*A.*) *moestus* (Banks), male genitalia.
Fig. 87.—*A.* (*Pompilinus*) *grandiflexionis* Evans, male genitalia.
Fig. 88.—*A.* (*P.*) *subcylindricus* (Banks), male genitalia.
Fig. 89.—*A.* (*P.*) *percitus* Evans, male genitalia.

PLATE XIV

Fig. 90.—*A.* (*P.*) *krombeini* Evans, male genitalia.
Fig. 91.—*A.* (*P.*) *cylindricus* (Cresson), male genitalia.
Fig. 92.—*A.* (*P.*) *californiae* Evans, male genitalia.
Fig. 93.—*A.* (*P.*) *estellina* (Banks), male genitalia.
Fig. 94.—*A.* (*P.*) *tenebrosus* (Cresson), male genitalia.
Fig. 95.—*A.* (*P.*) *insolens* (Banks), male genitalia.

PLATE XV

Fig. 96.—*A.* (*P.*) *clystera* (Banks), male genitalia.
Fig. 97.—*A.* (*P.*) *marginatus* (Say), male genitalia.
Fig. 98.—*A.* (*P.*) *stenotus stenotus* (Banks), male genitalia.
Fig. 99.—*A.* (*P.*) *stenotus bequaerti* (Dreisbach), male genitalia.
Fig. 100.—*A.* (*P.*) *rectangularis rectangularis* (Dreisbach), male genitalia.
Fig. 101.—*A.* (*P.*) *rectangularis gillaspyi* new subspecies, male genitalia.

PLATE XVI

Fig. 102.—*A.* (*P.*) *townesi* new species, male genitalia.
Fig. 103.—*A.* (*P.*) *splendens* (Dreisbach), male genitalia.
Fig. 104.—*A.* (*P.*) *fraternus* (Banks), male genitalia.
Fig. 105.—*A.* (*Anoplius*) *depressipes* Banks, male genitalia.
Fig. 106.—*A.* (*A.*) *nigerrimus* (Scopoli), male genitalia.
Fig. 107.—*A.* (*A*). *ithaca* (Banks), male genitalia.

PLATE XVII

Fig. 108.—*A.* (*A.*) *virginiensis* (Cresson), male genitalia.
Fig. 109.—*A.* (*A.*) *fulgidus* (Cresson), male genitalia.
Fig. 110.—*A.* (*A.*) *hispidulus* Dreisbach, male genitalia.
Fig. 111.—*A.* (*A.*) *basalis* Dreisbach, male genitalia.
Fig. 112.—*A.* (*A.*) *imbellis* Banks, male genitalia.
Fig. 113.—*A.* (*A.*) *illinoensis* (Robertson), male genitalia.

PLATE XVIII

Fig. 114.—*A.* (*A.*) *ventralis ventralis* (Banks), male genitalia.
Fig. 115.—*A.* (*A.*) *ventralis tarsatus* Banks, male genitalia.
Fig. 116.—*A.* (*Lophopompilus*) *aethiops* (Cresson), male sugenital plate.
Fig. 117.—*A.* (*L.*) *atrox* (Dahlbom), male subgenital plate.
Fig. 118.—*A.* (*Notiochares*) *amethystinus* (Fabricius), male subgenital plate.
Fig. 119.—*A.* (*Arachnophroctonus*) *apiculatus* (Smith), male subgenital plate.
Fig. 120.—*A.* (*A.*) *semirufus* (Cresson), male subgenital plate.
Fig. 121.—*A.* (*A.*) *americanus* (Beauvois), male subgenital plate.
Fig. 122.—*A.* (*A.*) *moestus* (Banks), male subgenital plate.

PLATE XIX

Fig. 123.—*A.* (*Pompilinus*) *cylindricus* (Cresson), male subgenital plate.
Fig. 124.—*A.* (*P.*) *grandiflexionis* Evans, male subgenital plate.
Fig. 125.—*A.* (*P.*) *subcylindricus* (Banks), male subgenital plate.
Fig. 126.—*A.* (*P.*) *percitus* Evans, male subgenital plate.
Fig. 127.—*A.* (*P.*) *krombeini* Evans, male subgenital plate.
Fig. 128.—*A.* (*P.*) *texanus* (Dreisbach), male subgenital plate.
Fig. 129.—*A.* (*P.*) *californiae* Evans, male subgenital plate.
Fig. 130.—*A.* (*P.*) *estellina* (Banks), male subgenital plate.
Fig. 131.—*A.* (*P.*) *rectangularis* (Dreisbach), male subgenital plate.
Fig. 132.—*A.* (*P.*) *stenotus* (Banks), male subgenital plate.
Fig. 133.—*A.* (*P.*) *splendens* (Dreisbach), male subgenital plate.
Fig. 134.—*A.* (*P.*) *clystera* (Banks), male subgenital plate.

PLATE XX

Fig. 135.—*A.* (*P.*) *tenebrosus* (Cresson), male subgenital plate.
Fig. 136.—*A.* (*P.*) *insolens* (Banks), male subgenital plate.
Fig. 137.—*A.* (*P.*) *fraternus* (Banks), male subgenital plate.
Fig. 138.—*A.* (*Anoplius*) *hispidulus* Dreisbach, male subgenital plate.
Fig. 139.—*A.* (*A.*) *basalis* Dreisbach, male subgenital plate.
Fig. 140.—*A.* (*A.*) *nigerrimus* (Scopoli), male subgenital plate.
Fig. 141.—*A.* (*A.*) *ventralis* (Banks), male subgenital plate.
Fig. 142.—*A.* (*A.*) *imbellis* Banks, male subgenital plate.
Fig. 143.—*A.* (*A.*) *illinoensis* (Robertson), male subgenital plate.
Fig. 144.—*A.* (*A.*) *ithaca* (Banks), apical tarsal segment of female.
Fig. 145.—*A.* (*A.*) *illinoensis* (Robertson), apex of abdomen of female.

PLATE XXI

Fig. 146.—*A.* (*Arachnophroctonus*) *relativus* (Fox), side view of propodeum and abdomen of male.
Fig. 147.—*A.* (*Anoplius*) *ventralis* (Banks), side view of propodeum and abdomen of male.
Fig. 148.—*A.* (*A.*) *basalis* Dreisbach, side view of abdomen of male.
Fig. 149.—*A.* (*A.*) *hispidulus* Dreisbach, side view of abdomen of male.
Fig. 150.—*A.* (*A.*) *virginiensis* (Cresson), side view of abdomen of male.
Fig. 151.—*A.* (*Pompilinus*) *marginatus* (Say), side view of propodeum of male.
Fig. 152.—*A.* (*Arachnophroctonus*) *relativus* (Fox), wings.
Fig. 153.—*A.* (*Pompilinus*) *marginatus* (Say), wings.
Fig. 154.—*A.* (*Anoplius*) *illinoensis* (Robertson), wings.
Fig. 155.—*A.* (*Pompilinus*) *texanus* (Dreisbach), male genitalia.

PLATE XXII

Fig. 156.—*A.* (*P.*) *krombeini* Evans, head of female.
Fig. 157.—*A.* (*P.*) *insolens* (Banks), head of female.
Fig. 158.—*A.* (*P.*) *percitus* Evans, head of female.
Fig. 159.—*A.* (*Anoplius*) *hispidulus* Dreisbach, head of female.
Fig. 160.—*A.* (*A.*) *basalis* Dreisbach, head of female.
Fig. 161.—*A.* (*Pompilinus*) *marginatus* (Say), side view of propodeum of female.
Fig. 162.—*A.* (*P.*) *splendens* (Dreisbach), side view of propodeum of female.
Fig. 163.—*A.* (*Anoplius*) *nigerrimus* (Scopoli), last segment of front tarsus of male.
Fig. 164.—*A.* (*A.*) *ventralis* (Banks), last segment of front tarsus of male.
Fig. 165.—*A.* (*Pompilinus*) *marginatus* (Say), hind basitarsus of male.
Fig. 166.—*A.* (*Anoplius*) *illinoensis* (Robertson), front basitarsus of female. U, upper row of spines; L, lower row of spines.
Fig. 167.—*A.* (*A.*) *imbellis* Banks, basal two segments of front tarsus of female.

Fig. 168.—*A.* (*A.*) *fulgidus* (Cresson), front basitarsus of female.

Fig. 169.—*A.* (*A.*) *depressipes* Banks, basal two segments of front tarsus of female.

Fig 170.—*A.* (*A.*) *virginiensis* (Cresson), front basitarsus of female.

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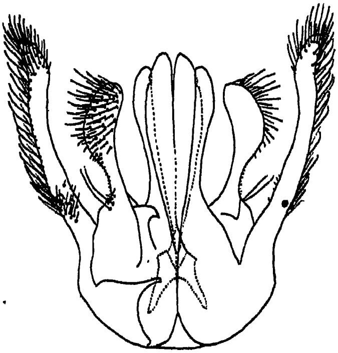

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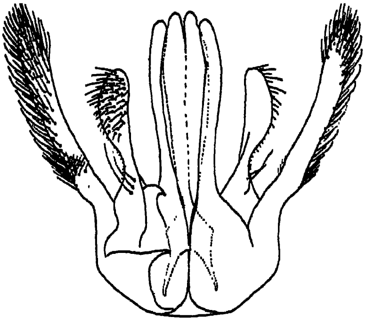

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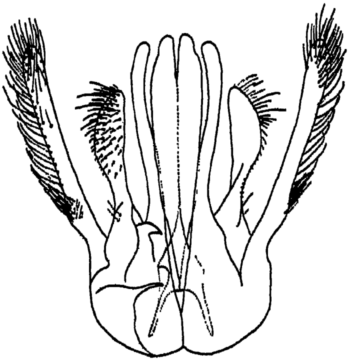

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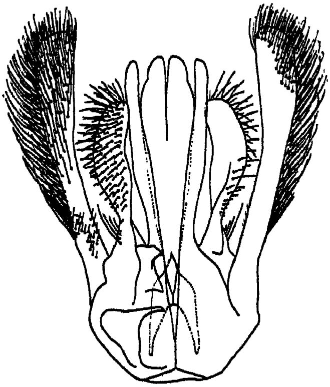

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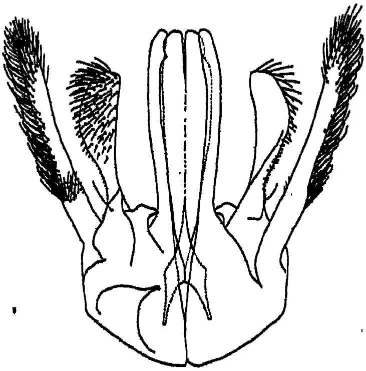

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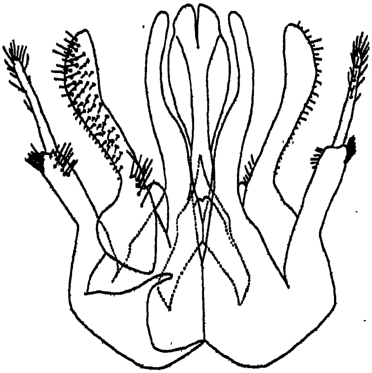

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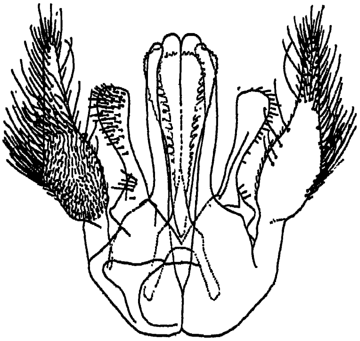
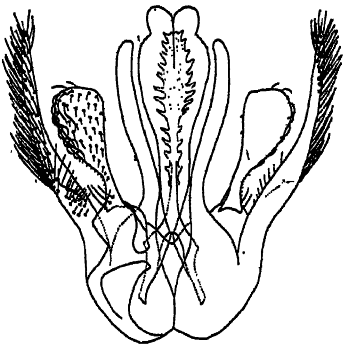
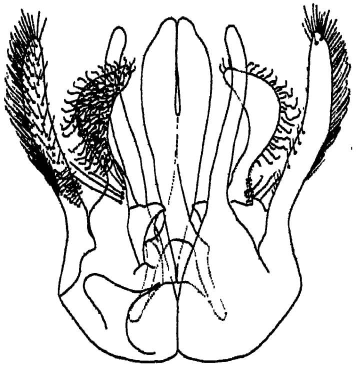
EVANS—NEARCTIC SPIDER WASPS







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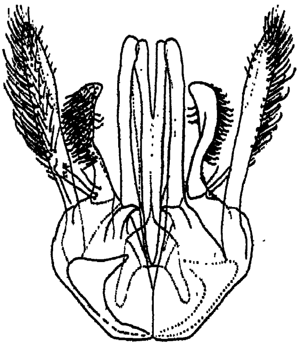

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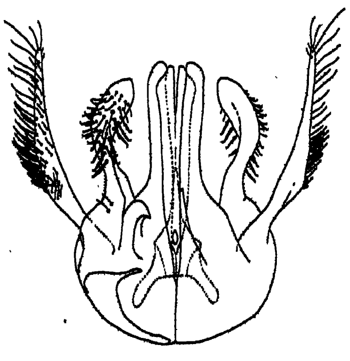

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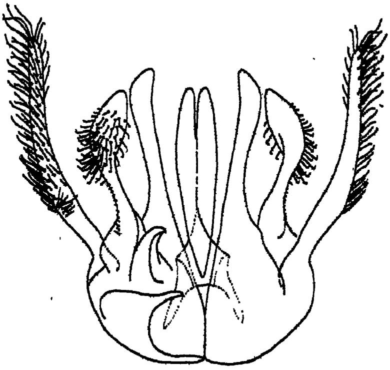

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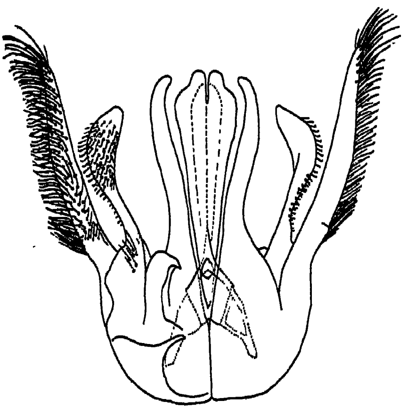

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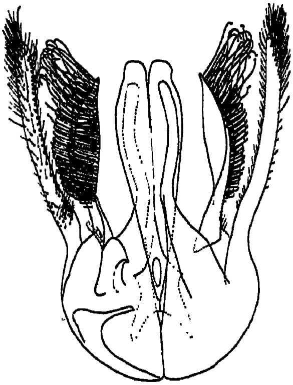

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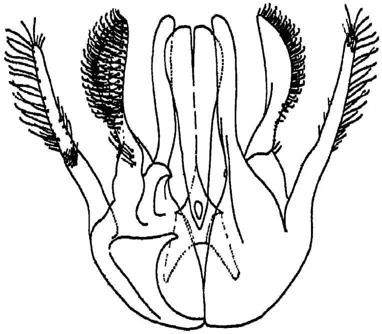

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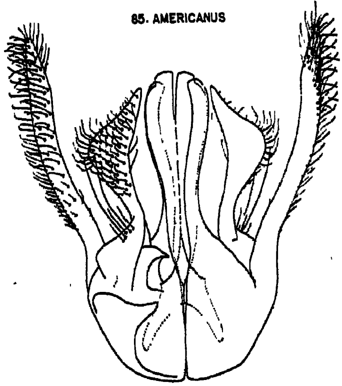

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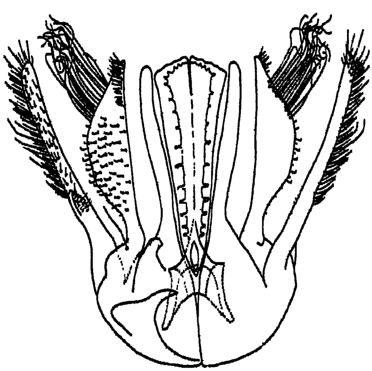

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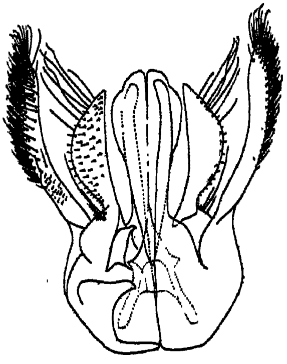

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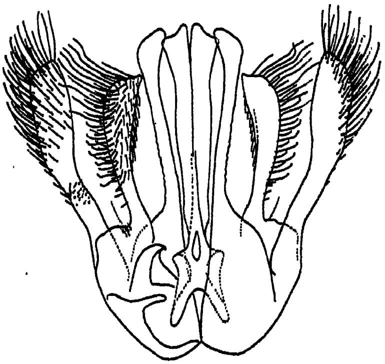

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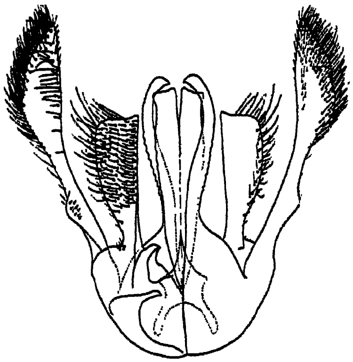

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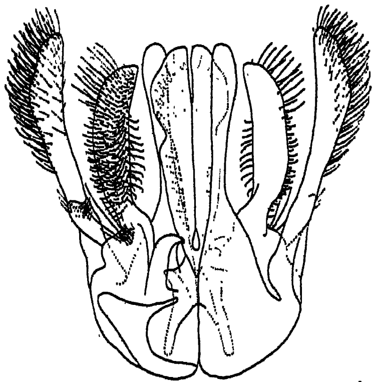

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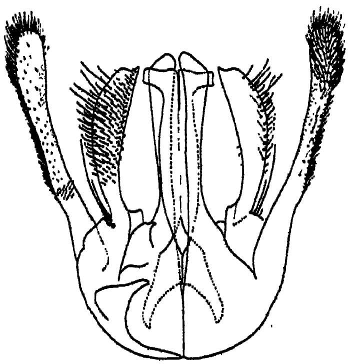

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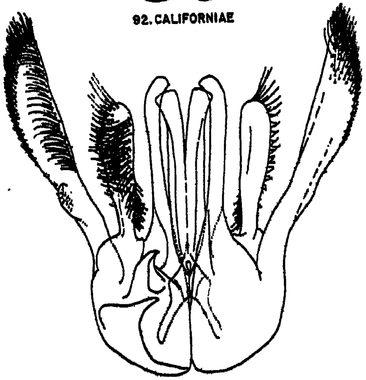

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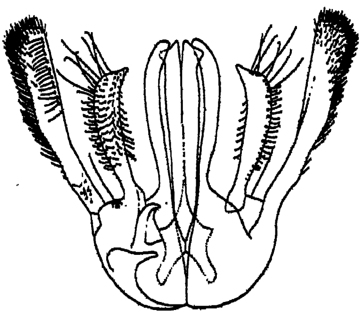

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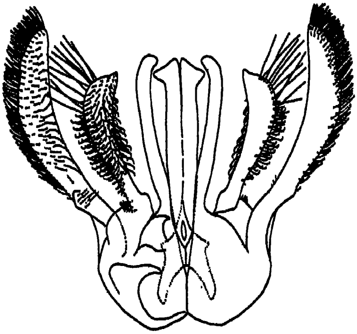
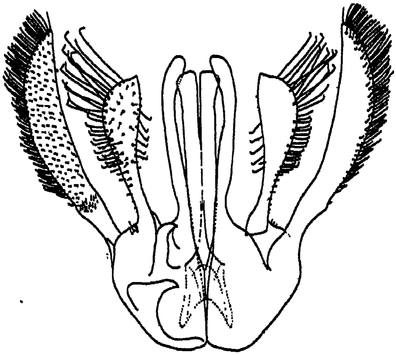
EVANS—NEARCTIC SPIDER WASPS





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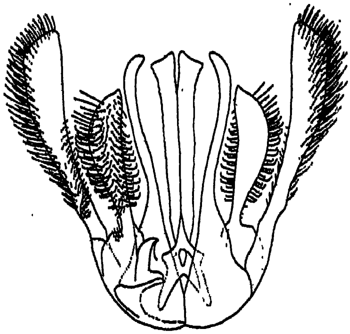

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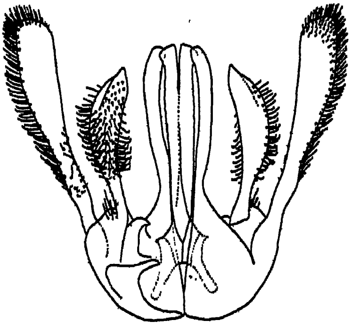

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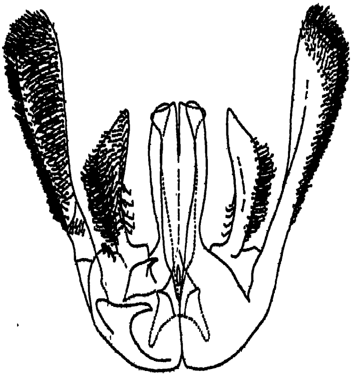

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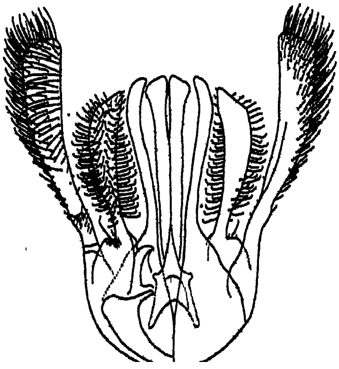

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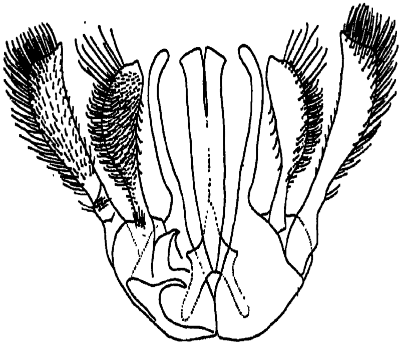

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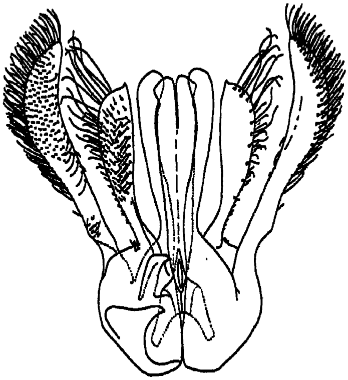

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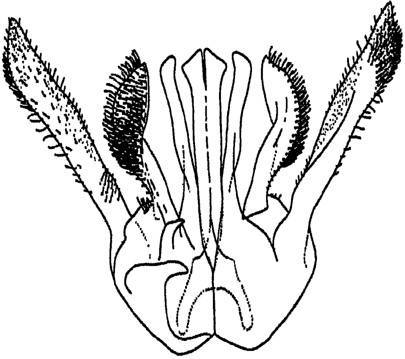

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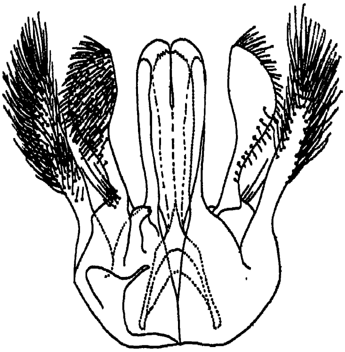

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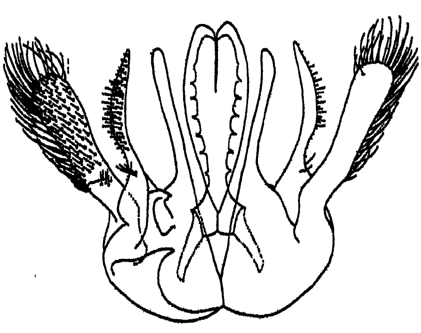

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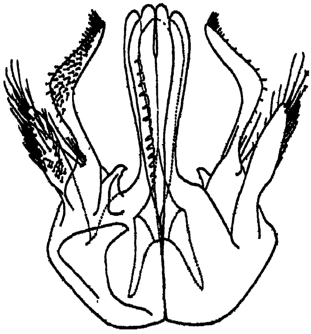
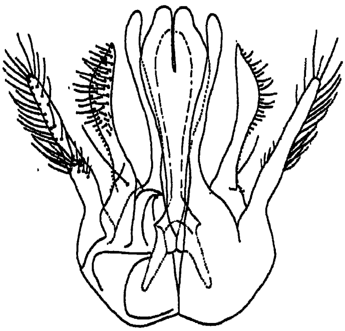


107. I

EVANS—NEARCTIC SPIDER WASPS



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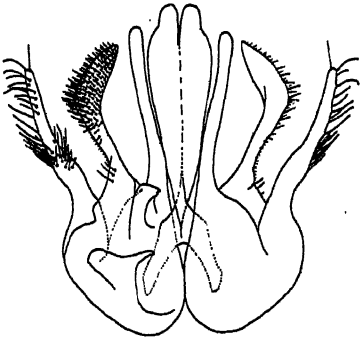

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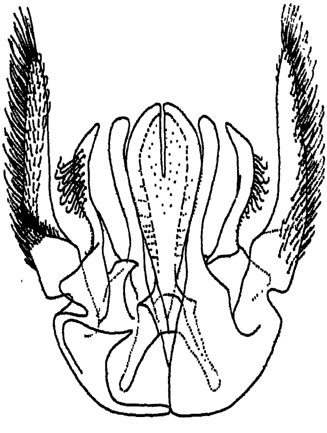

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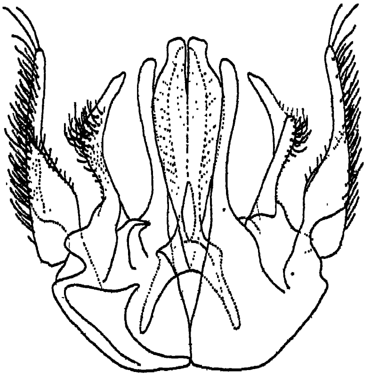

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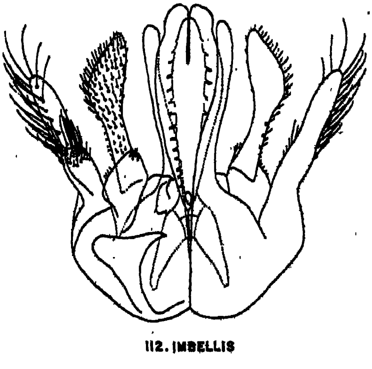

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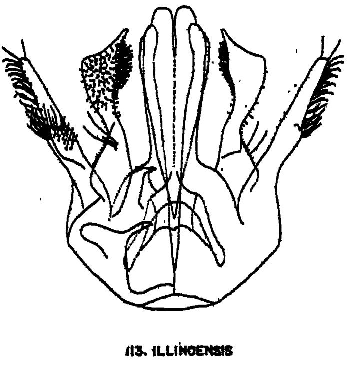

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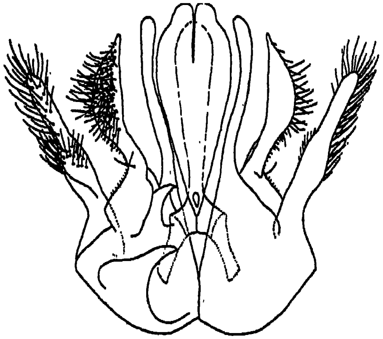
EVANS—NEARCTIC SPIDER WASPS



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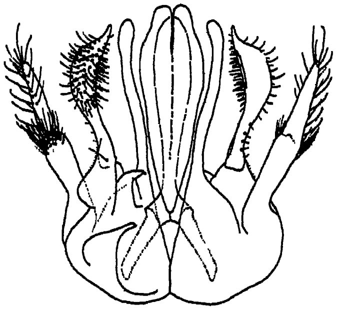

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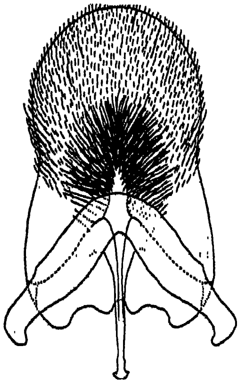

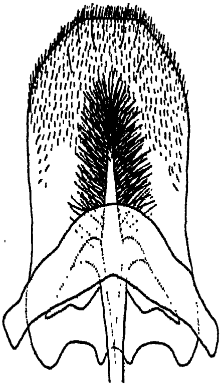

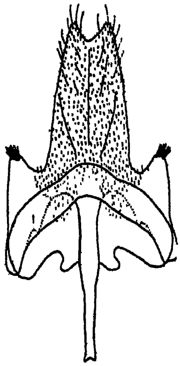

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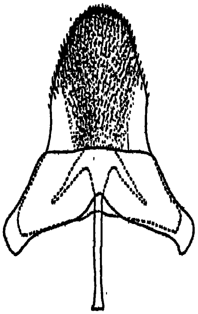

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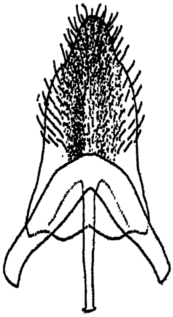

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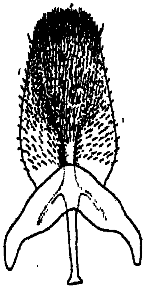

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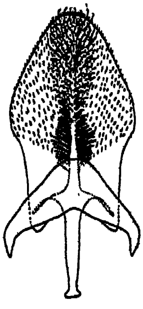

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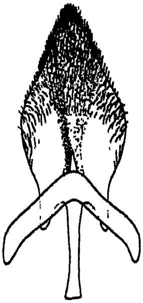
EVANS—NEARCTIC SPIDER WASPS



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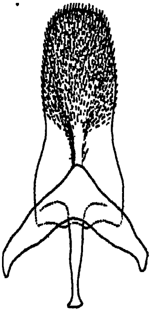

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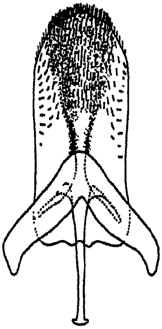
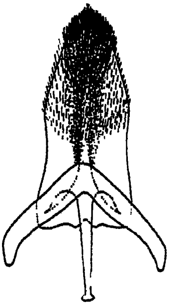
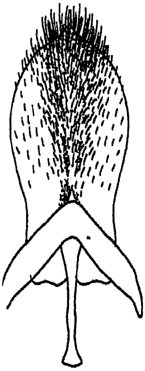


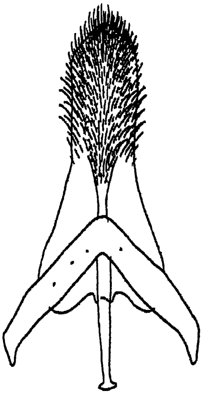
125. SUBCYLINDRICUS



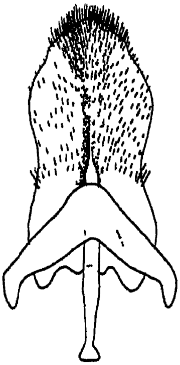
126. PERCITUS



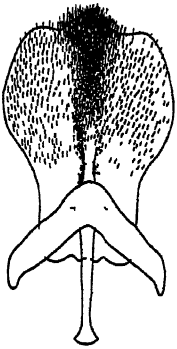
127. KROMBEINI



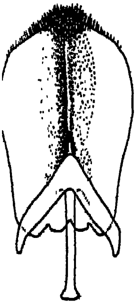
128 TEXANUS



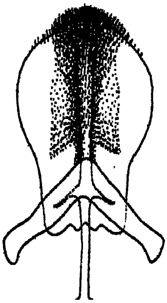
129. CALIFORNIAE



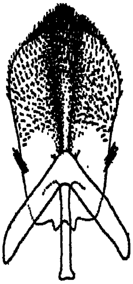
130. ESTELLINA



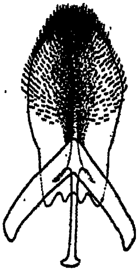
131. RECTANGULARIS



132. STENOTUS

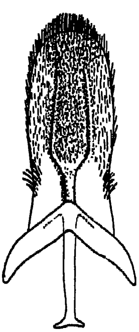


133. SPLENDENS



134. CLYSTERA

EVANS—NEARCTIC SPIDER WASPS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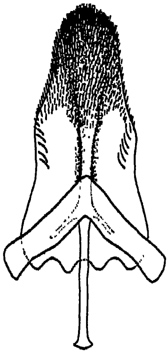
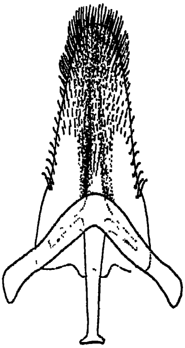
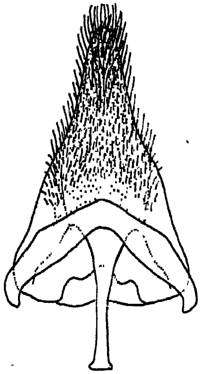
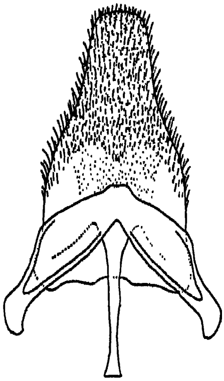
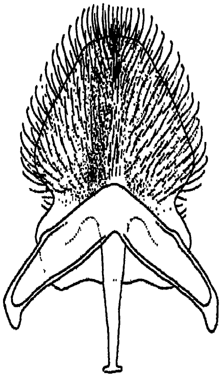
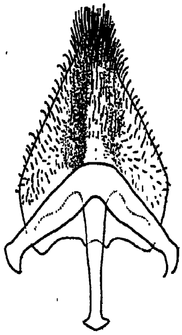

136. INSOLENS

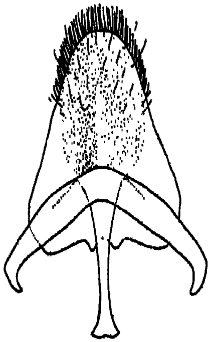

137. FRATERNUS

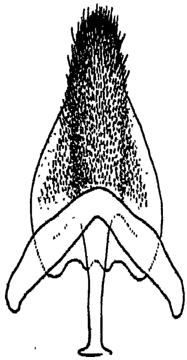

138. HISPIDULUS

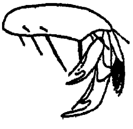

139. BASALIS

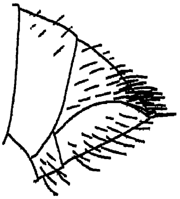

140. NIGERRIMUS


141. VENTRALIS

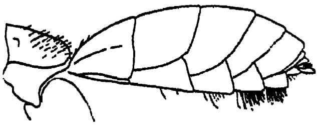

142. IMBELLIS


143. ILLINOENSIS

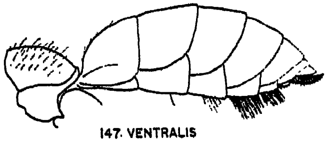

144. ITHACA


145. ILLINOENSIS

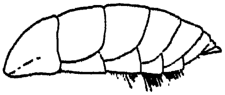
EVANS—NEARCTIC SPIDER WASPS



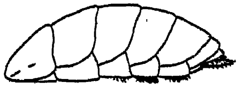
146. RELATIVUS



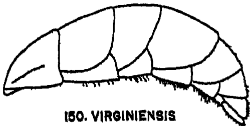
147. VENTRALIS



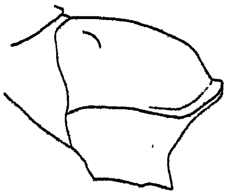
148. BASALIS



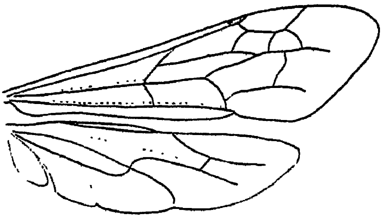
149. HISPIDULUS



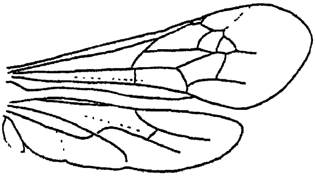
150. VIRGINIENSIS



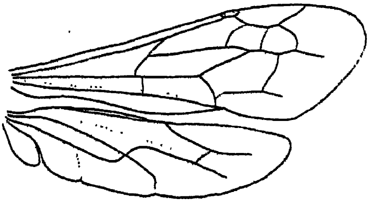
151. MARGINATUS



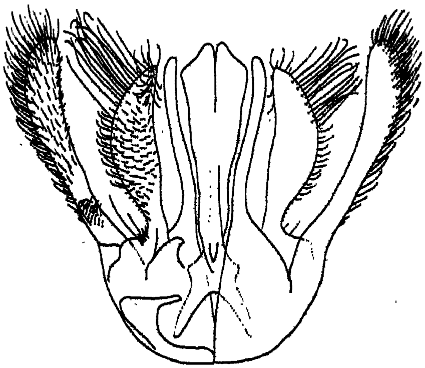
152. RELATIVUS



153. MARGINATUS

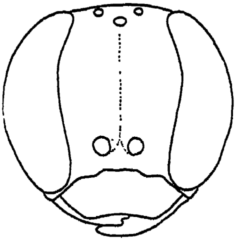


154. ILLINOENSIS

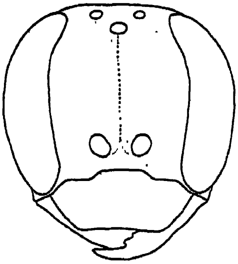


155. TEXANUS

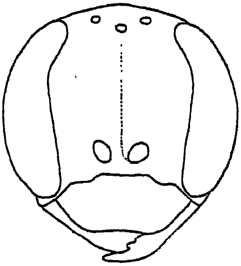
EVANS—NEARCTIC SPIDER WASPS



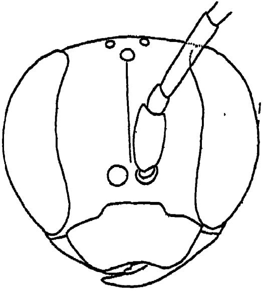
156. KROMBEINI



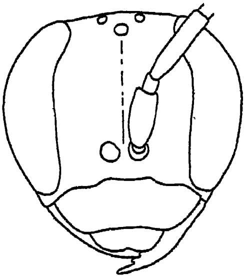
157. INSOLENS



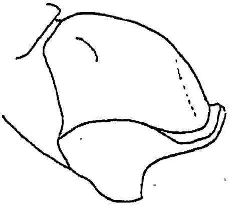
158. PERCITUS



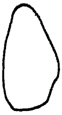
159. HISPIDULUS



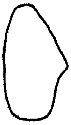
160. BASALIS



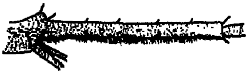
161. MARGINATUS



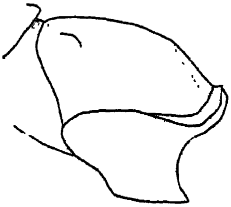
163. NIGERRIMUS



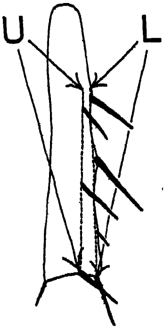
164. VENTRALIS



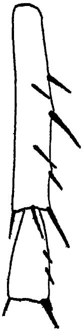
165. MARGINATUS



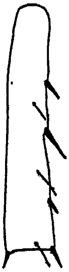
162. SPLENDENS



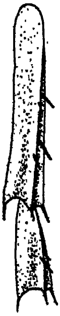
166. ILLINOENSIS.



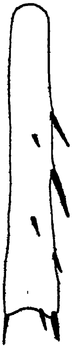
167. IMBELLIS



168. FULGIDUS



169. DEPRESSIPES



170. VIRGINIENSIS

THREE NEW CENTRAL AMERICAN MANTOIDEA (ORTHOPTERA)

BY JAMES A. G. REHN

Curator of Insects, Academy of Natural Sciences of Philadelphia

(Plates XXIII to XXV)

In the course of field studies accumulating material for their investigations on the cytology of species of Mantoidea, Drs. Franz Schrader and Sally Hughes-Schrader, of the Department of Zoology of Columbia University, have brought to light much new and important information bearing upon the cytology, systematics, ecology and behavior of these insects. In the present paper three undescribed species are characterized, most of the information on which we owe to the interest and energy of the above-mentioned colleagues.

EREMIAPHILINAE

Mantoida schraderi [1] new species (Figures 1-5.)

The discovery of this species necessitated an examination of all the available material of the genus, particularly that from north of Amazonia, with the result that a recasting of our understanding of the genus as occurring in that general region is necessary. This is in part being done in a separate paper, but this species is here described to make the specific name promptly available for use in cytological studies by its discoverers.

In some respects *schraderi* is closer to certain other species than it is to *M. maya* Saussure and Zehntner, the sole member of the genus previously recorded from north of Panama, but until more material of both sexes of a number of other species is available, including *M. maya,* it will not be possible to present a really comprehensive analysis, or to determine more accurately the relationships and variability of some of the species of this infrequently collected genus.

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[1] In appreciation of the cooperation of Dr. Franz Schrader and Dr. Sally Hughes-Schrader, and of their recognition of the fundamental unity of purpose of the various fields of study of the biological sciences.

When compared with males of *M. maya* Saussure and Zehntner,[2] from Venvideo, Sinaloa, Mexico,[3] that sex of *schraderi* differs chiefly in the head being narrower between the eyes, in the latter being somewhat more prominent, particularly as seen from the dorsum, in the facial shield being less strongly transverse and somewhat deeper proportionately mesad, and in the less elongate character of elements of the limbs, this particularly evident in the cephalic metatarsi and in the caudal femora. In the female sex, of which unfortunately I have no *maya* material, the relationship is closest to a new Colombian species which is being described in another paper, and which will be compared with *schraderi.*

As to other South American species the present one is definitely larger than *tenuis* Perty or *luteola* Westwood, and its eyes are markedly more prominent than in *fulgidipennis* Westwood, which latter also has a much more decided and contrasted color pattern.

Whether the pale premedian annulus of the antennae of the type is a sexual character, or is an individual color variation, remains to be determined. In regard to this see the color description on a following page.

Type.—♀; Turrialba, Costa Rica. May 25, 1944. (Dr. Franz Schrader, no. 319.) [Academy of Natural Sciences of Philadelphia, Type no. 5715.]

Size medium for genus (length of body, 17.5 mm.); general form and sculpture as usual in the genus.

Head as viewed in cephalic aspect with its greatest depth equal to three-fourths of the greatest head breadth, the latter approximately 1.48 times that of the pronotum; occipital outline transversely arcuate, well cut off from the eye outlines, as seen in profile the occiput is also arcuate longitudinally, evenly rounding ventro-cephalad to the transverse subsigmoid supra-ocellar carinula; ocelli of medium size, disposed in a rather low triangle, the ventral (median) one bisecting the arcuato-obtuse-angulate infraocellar carinula; facial shield strongly transverse, its greatest median depth equal to but two-sevenths (as 10 to 35) of its greatest breadth, dorsal margin moderately oblique laterad, very narrowly truncate mesad, ventral margin as a whole concave, more strongly so laterad; eyes quite full, moderately globose, as viewed in profile with longitudinal dimension of eye outline but slightly less than eight-ninths of the depth of the same (as 32 to 38). Antennae elongate, when extended caudad reaching approximately to the tegminal apices, setaceous, multi-articulate.

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[2] Biol. Cent.-Amer., Orth., I, p. 125, pl. X, figs. 26 and 27, (1894). [♀; Temax, northern Yucatan.]

[3] Recorded by Hebard, Trans. Amer. Entom. Soc., XLVIII, p. 182, (1923). No material is available from Yucatan, but I have before me an imperfect male from Belize, British Honduras.

Pronotum of the broad and short sub-hexagonal type usual in the genus, its greatest breadth equal to more than nine-tenths of its length; cephalic margin, as seen from the dorsum, concave-emarginate mesad, broadly arcuate thence caudo-laterad to the immediate supra-coxal area, lateral margins appreciably convex caudad of the supra-coxal area to the moderate constriction where the lateral margins pass into the sub-bisarcuate caudal margin, which latter mesad is more broadly and more shallowly arcuate-emarginate than the cephalic one, all margins strongly cingulate by the relief of paralleling internal sulciform impressions; transverse sulcus dividing prozona (collar) from metazona (shaft) deeply impressed and crossing the entire surface, prozona (collar) very slightly shorter than the metazona (shaft) (as 23 to 26), as seen in profile the dorsal line of the prozona is moderately arcuate from the intra-marginal sulcus, that of the metazona virtually straight, ventral margin of lateral lobes nearly straight.

Tegmina surpassing the abdominal apex by a distance almost equal to the pronotal length, hyaline, general form and principal venation as in *M. maya*. Wings, when closed, equalling the tegmina in length.

Cerci reaching caudal virtually to the apices of the valves of the subgenital plate, tapering, submoniliform, composed of twelve articles, those proximad much shorter than the more distal ones; subgenital plate with the distal rostrate section appreciably compressed, its values, as seen in profile, rounded acute, directed ventro-caudad.

Cephalic coxae, as usual in the genus, short and stout, their length subequal to that of the pronotum, roughly triquetrous in cross-section, external surface deplanate, internal surface and narrower flexor section appreciably bulbous as usual in the genus, both flexor and extensor borders of external surface carinulate, the coxa narrowing regularly distad from the thicker base; cephalic femora 1.3 times as long as the cephalic coxae, of the inflated type proximad and internally usual in the genus, the whole narrowing regularly distad, the greatest thickness equal to two-sevenths of the femoral length (as 20 to 70), the greatest depth (dorsad of the discoidal spines) to two-fifths of the length (as 28 to 70), external surface of the femora with two longitudinal sulciform impressions, the more dorsal extending from near the distal extremity to slightly proximad of the middle, the more ventral, which is near to and arcuately parallels the ventral border of this surface, extends proximad to dorsad of the discoidal spines, ventro-external (external flexor) border with four relatively short and stout, well and regularly spaced, spines, none at genicular extremity, ventral (flexor) surface of femur distad of discoidal spine broad and shallowly but distinctly excavate transversely, ventro-internal (internal flexor) border with sixteen relatively short and uniformly sized spines, except for several of the series at the proximal end which are mere nodes,[4] while distad these spines are distributed in a double series, one distinctly internal to the other, while the spines of the same margin of the tibiae close on the intervening space, distal brush of chaetae on internal surface dense and relatively extensive, discoidal spines three in number, the more proximal one slightly the larger and directed proximad, while the others have the same inclination as the marginal spines; cephalic tibiae with apical claw reaching virtually to the internal base of the femur, depressed triquetrous in cross-section, extensor surface tectately subcarinate, curving distad outward to tarsal insertion, ventro-external (flexor external) margin with four spaced and inclined spines in distal half, ventro-internal (flexor internal) margin with eight spines (exclusive of apical claw) in distal three-fifths, these increasing in length distad, the proximal two-fifths of this margin unarmed, apical claw very long and slightly arcuate; cephalic tarsi as a whole equal to 1.5 times the length of the cephalic tibiae (including apical claw), the metatarsus slightly longer than the remainder combined (as 47 to 43). Median femora over 1.1 times as long as the cephalic femora, relatively stout (for a mantid), tapering distad as seen from the dorsum, the dorsal and lateral surfaces broadly arcuate transversely, ventral (flexor) surface deplanate; median tibiae slightly shorter than the femora. Caudal femora slightly longer than the median or one and two-fifths times as long as the cephalic femora, much more compressed than the median femora and tapering distad from proximal fourth in both aspects, subcylindrical except for a moderate ventral (flexor) deplanation; caudal tibiae slightly longer than the femora (as 103 to 95); caudal tarsi as a whole nearly four-fifths as long as the tibiae (as 80 to 103), the metatarsus comprising slightly more than half the tarsal length (as 45 to 80).

Allotype.—♂; Barro Colorado Island, Gatun Lake, Canal Zone, Panama. March 31, 1924. (J. C. Bradley.) [Academy of Natural Sciences of Philadelphia.]

Differing from the preceding description of the type in the following noteworthy respects.

Size somewhat smaller (length of body, 14.3 mm.); form somewhat more slender, as usual in this sex of the genus.

Head proportionately broader and shallower, the greatest depth equal to but five-sevenths of the greatest head breadth, the latter equal to 1.79 times that of the pronotum; occipital outline more strongly arcuate than that of the female sex, more sharply cut off from the eye outlines, supra-ocellar carinula less appreciably subsigmoid laterad; ocelli large and protuberant as usual in the male sex, their relative position as in the female; eyes slightly more protuberant and bullate than in the female, more globose as seen in cephalic aspect. Antennae longer than in the female sex, when extended caudad surpassing the tegminal apices by a distance at least equal to the combined length of the head and pronotum.

Pronotum of the same general shape and with the same sculptural features except that it is slightly shorter and broader, with its greatest length and greatest breadth subequal.

Tegmina surpassing the apex of the abdomen by a distance equal to the combined length of the head and pronotum; longitudinal intercalated venation almost absent except close to the distal and sutural margins of the discoidal field, while in the female sex these veins in a connected or detached fashion extend as a whole an appreciably greater distance proximad in the distal half of the tegmina.

Supra-anal plate shallowly transverse trigonal; cerci moderately surpassing the apex of the subgenital plate, with ten evident articles which regularly increase in length and slenderness distad, the more proximal ones strongly moniliform, the distal relatively linear; subgenital plate semi-ovate in outline, the interstylar section of the margin narrowly and shallowly notched, styles no longer than the interval between their bases, about which latter the plate surface is weakly elevated and thickened.

Limbs as a whole basically as in the female but more slender, particularly the median and caudal ones. Cephalic coxae slightly longer than the pronotum (as 45 to 40); cephalic femora with their greatest thickness equal to slightly more than one-third of their length (as 20 to 57), the greatest depth proportionately as in the female (as 23 to 57), their sculpture as in female. Median femora 1.25 times as long as the cephalic femora, appreciably more slender than in the opposite sex; caudal femora lacking in allotype but a paratypic male shows they are similar to but more slender proximad than in the female.

Measurements.—Length of body, ♀ type, 17.5 mm., ♂ allotype, 14.3; greatest breadth of head, ♀ type, 4, ♂ allotype, 3.7; length of pronotum, ♀ type, 2.7, ♂ allotype, 2; greatest breadth of pronotum, ♀ type, 2.5, ♂ allotype, 2.1; length of tegmen, ♀ type, 16.1, ♂ allotype, 15.6; greatest breadth of tegmen, ♀ type, 3.4, ♂ allotype, 2.9; length of cephalic coxa, ♀ type, 2.7, ♂ allotype, 2.2; length of cephalic femur, ♀ type, 3.5, ♂ allotype, 3; length of median femur, ♀ type, 4, ♂ allotype, 3.7; length of caudal femur, ♀ type, 5, ♂ allotype, lacking; length of caudal tibia, ♀ type, 5.7, ♂ allotype, lacking.

Coloration.—General base color slate-olive, varying to as dark as deep slate-green, the abdomen broadly as dark as fuscous-black in the type, while in the allotype and paratypic male this is limited to a medio-longitudinal bar on its ventral surface, limbs largely isabella color to as dark as olive; overlying dark areas of body surface bone brown to fuscous-black, almost all of the head and pronotum so colored, the pronotum laterad in the type with more of the pale base color evident than in the other individuals. Antennae fuscous with a broad premedian annulus in the female type and the female immature individual; in the males they are solidly fuscous. Eyes ranging from nearly solid fuscous to paler with dorsal aspect and numerous dots elsewhere fuscous. Ocelli yellow to orange. Alar organs moderately infumate, the costal borders of both quite heavily pencilled with bone brown, the venation of the latter tone. In the female type the cephalic coxae, the proximal section of the median and caudal femora and the internal face of the cephalic femora are pale, the remainder of the limbs largely dark; in the males the limbs as a whole are paler, but the areas of relative tonal values are much as in the female.

Material examined.—In addition to the type and allotype I have before me in the Academy series a paratypic male, taken at Barro Colorado Island, Canal Zone, Panama, January 2, 1949, by Dr. Franz Schrader, and an imperfect immature female individual taken at Old Panama, Panama, January 31, 1911, by E. A. Schwarz. The sex of the latter specimen can be determined from the ocelli and head structure, although it lacks the abdomen and all limbs except a single cephalic one.

Habits.—Dr. Sally Hughes-Schrader has kindly supplied the following notes on the specimens of this species taken by the Schraders. The type was " perched on a fence post, at that end of a field which adjoined second growth forest along a small creek tributary to the Rio Reventazón on the land of the U. S. Department of Agriculture Rubber Experiment Station, Turrialba. She was extremely lively, nervous, with antennae in constant motion. Coloration blent marvellously with that of the lichen and moss covered post. We searched this area intensively on succeeding days [1944] and again in 1948, but always in vain." The paratypic male was " attracted to night light at laboratory building overlooking heavy forest in the barranca below on Barro Colorado Island. The *Mantoida* never settled down on the reflector sheet, but flew rapidly back and forth around the light bulb. Its whole behavior was nervous, antennae dancing, and its course erratic—quite different from any other mantid I have observed."

LITURGOUSINAE

In the course of their study of the cytology of Canal Zone and Costa Rican species of the genus *Liturgousa* the Doctors Schrader discovered that the series of the genus they had secured contained two new species, which differed materially in their cytology, and also showed well-marked external morphological differences. At their request I found that both entities were undescribed, although one of them had been confused by me in 1935 with the Guianan *L. annulipes,* and was so recorded in my study of the Costa Rican members of the family. The two new species are here described.

Liturgousa cursor[5] new species (Figures 6-11.)

1935. *Liturgousa annulipes* Rehn, Proc. Acad. Nat. Sci. Phila., LXXXVII, p. 199, pl. 8, fig. 4. [Hamburg Farm and La Emilia, Costa Rica; "Costa Rica".] (Not *L. annulipes* (Serville).)

At the time the Costa Rican material above referred to was studied, no male and but poor female material of true *annulipes* (from the Guianas) was available, hence the erroneous association then made. The present comparison is made with a male of *annulipes* from Kartabo, Bartica District, British Guiana, and a female of the same from Nouveau Chantier, French Guiana, in the collection of the Academy.

From *annulipes* the present species differs in both sexes in the longitudinal sectors of the tegmina being less divergingly radiating and more subparallel in their course to the margins, in the less conspicuous cross-veins of the tegmina, in the smoother and non-denticulate external surface of the cephalic femora, and in the latter being more slender, while the median and caudal femora are thicker and stouter. The male sex of *cursor* also differs from *annulipes* by the surface of the pronotum lacking the weak and scattered minute shagreenous points seen in that sex of *annulipes,* by having the pronotum more slender throughout, and by the marginal field of the tegmina being proportionately narrower. In the female sex *cursor* also differs from *annulipes* in having the pronotum proportionately shorter and thicker, with the collar somewhat broader.

Apparently *cursor* also possesses a more zebroid type of color pattern, with more numerous maculae and lineations, but the available material of *annulipes* is not in sufficiently good shape to make comparison of this, as well as of various other features which appear to show differences in the two species. Any consideration of these must await the receipt of more and better material of *annulipes.*

A comparison of *cursor* and *actuosa* is given under the latter species.

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[5] I. e. *a runner,* in allusion to the actions of members of this genus in scuttling about on the trunk of a tree.

Type.—♂; Barro Colorado Island, Gatun Lake, Canal Zone, Panama. December 31, 1948. (Dr. Franz Schrader, no. 630.) [Academy of Natural Sciences of Philadelphia, Type no. 5761.]

Size relatively small for genus (length of body, 20 mm.); form of the type usual in the genus; surface smooth, tegmina with none but principal longitudinal venational elements at all elevated.

Head distinctly transverse, its greatest depth contained 1.4 times in the breadth across eyes (as 17 to 24), occipital line as seen in cephalic aspect very faintly concave between the distinct but strongly rounded juxta-ocular lobes, vertical facial sulci well marked, bent arcuate; ocelli quite small (for the sex), placed in a very low and broad triangle; facial scutellum strongly transverse and very shallow, in general form almost brace-shaped, the ventral margin strongly concave, the dorsal distinctly elevated mesad in the infra-ocellar area, and laterad obliquely subconcave beneath each antenna, the lateral margins appreciably arcuate, surface of scutellum deplanate except for slight thickenings laterad; eyes prominent and appreciably globose as seen in cephalic aspect, when viewed from the dorsum the portions of the head laterad of the facial sulci are directed moderately latero-cephalad. Antennae surpassing the body length by a distance approximately equal to the pronotal length, setaceous.

Pronotum moderately slender, its greatest supra-coxal breadth contained 3.3 times in its length (as 13 to 43), while the metazonal (shaft) length constitutes over seven-tenths of the total pronotal length (as 31 to 43), precoxal sections of the lateral margins of the prozona (collar) parallel and straight, passing evenly into the broadly arcuate cephalic margin, margins of the supra-coxal dilation moderately and lengthily arcuate, evenly passing into the shallowly concave lateral margins of the metazona (shaft), greatest breadth of latter near caudal extremity faintly greater than that of prozona (collar), least breadth of metazona mesad equal to nearly seven-tenths of that across supra-coxal lobes (as 9 to 13), caudal margin arcuate, medio-longitudinal impression evident on all of prozona (collar) but more finely and narrowly indicated cephalad, on metazona (shaft) it is distinct cephalad but gradually changes into a low carinula near caudal margin, transverse sulcus separating prozona and metazona well impressed, surface of prozona in caudal third with low cephalo-laterad diverging arcuate raised areas which when they near the lateral margins as very low carinulae are carried forward, parallel to these margins, ultimately rounding to the cephalic point of the pronotum; lateral margins entire and unarmed except for very weak and spaced denticulations on the metazona.

Tegmina when closed reaching virtually to the abdominal apex, elongate elliptical in outline, the costal and sutural margins in considerable part of distal half broadly subparallel, greatest breadth of distal third contained nearly 3.5 times in the tegminal length; costal margin nearly straight, briefly arcuate to the base and more sharply to the apex, which latter is somewhat nearer the costal than the sutural margin, latter relatively straight, passing into a suboblique truncato-arcuate apical margin; marginal field relatively narrow, broadest at proximal sixth, thence regularly narrowing distad; principal venation finely marked, major discoidal sectors four in number, as a whole approximately parallel and not appreciably radiating as in *annulipes*, cross-veins much less evident than longitudinal ones, somewhat less complex in areolation than in *annulipes*. Wings when closed reaching to the tegminal apices, their apices arcuato-truncate, greatest breadth of wings equal to two-thirds of their length (as 40 to 60).

Supra-anal plate very short, strongly transverse, the margin very shallowly and broadly notched mesad, weakly bisarcuate with the supra-cercal sections subconcave; cerci appreciably surpassing the subgenital plate, tapering, the articles 13 in number, very short proximad and regularly increasing in length distad, moniliform except that the distal one is narrow, acute styliform and equal to 1.5 times the length of that preceding; subgenital plate scoop-shaped, narrowing distad, the apex divided by a median gutter-like depression, which, however, extends but a short distance proximo-ventrad over the external surface of the plate, the thus divided "wings" of the apex compressed and briefly sublamellate, rounded subacute in outline as viewed in profile and somewhat compressed as viewed in caudal aspect, no evident styles.

Cephalic limbs relatively slender; cephalic femora with their length but slightly less than that of the pronotum, their greatest depth, as seen in profile, contained faintly more than 5.5 times in their length (as 7 to 39), dorsal margin as seen in profile straight for most of its length but very faintly concave distad, external surface moderately bullate between the dorsal intra-marginal sulcus and that intra-marginal to the ventro-external (external flexor) margin,[6] its surface smooth and without raised denticles (these present in *annulipes*), ventro-external (external flexor) margin with five spaced and slender spines, the distal one somewhat shorter and juxtagenicular in position, the two more proximal ones more closely placed than any of the others, internal to and parallel to these spines is placed a series of more numerous minute denticles, which are obsolete distad and reach proximad to between the two more proximal spines, while a few similar denticles are scattered over the ventral surface internal to the serially arranged denticles, ventro-internal (internal flexor) margin with 17 or so spines, the distal one subgenicular in position and shorter than the succeeding one, which is the longest in the series, these spines on the margin itself show the following length formula (reading distad) IIiiiIiIiIiiIi,[7] in addition to which there is a proximal internal closely placed pair of the shorter category, discoidal spines four in number, one under the apical claw, the others more proximal on the ventral (flexor) surface of the femur, that under the claw and the more proximal one of the series the shorter; cephalic tibiae with apical claw equal in length to seven-tenths that of the femora, the claw arcuate, its base forming an obtuse angle to the tibial axis, ventro-external (external flexor) margin with seven spines, the second and seventh of which (reading distad) are larger and longer than the others, with a greater diastema between the first and second than between the others, ventro-internal (internal flexor) margin with nine spines exclusive of the apical claw, these regularly increasing in length distad; cephalic tarsi slender, almost as long as the cephalic femora (as 130 to 137), the metatarsus comprising half of the tarsal length, its base with a distinct flexure where it fits between the spines on the ventro-external margin and the discoidal spines, remaining cephalic tarsal articles all markedly slender. Median femora approximately 1.25 times as long as the cephalic femora (as 170 to 137), moderately stout proximad for the sex and the genus, evenly tapering distad, extensor margin with a distinct but low carinula which proximad becomes merely a surface angulation; median tibiae equal to three-fourths of the femoral length, slender, appreciably compressed; median tarsi equal to approximately five-sixths of the tibial length (as 110 to 130). Caudal femora equal to approximately 1.25 times the pronotal length, more slender and more compressed than the median, similarly and more definitely carinulate; caudal tibiae slightly longer than the caudal femora (as 182 to 175); caudal tarsi similarly surpassing the tibial length (as 200 to 182), the metatarsus occupying three-fifths of the tarsal length.

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[6] This latter sulcus is subobsolete in the distal half of the femur, while the dorsal one is well evident for virtually the entire femoral length.

[7] Sometimes some of the smaller ones near the distal end of the series become obsolete. This is true of one femur of the type.

Allotype.— ♀; Castilla Farm, lower Rio Reventazón, Costa Rica. July 23, 1936. (C. W. Dodge.) [Academy of Natural Sciences of Philadelphia.]

The following features are those of noteworthy difference from the above description of the type.

Size distinctly larger than in male sex (length of body, 28.2 mm.); form somewhat more robust, as usual in this genus; surface no more rugose than in male.

Head essentially as in male; supra-ocellar transverse carina more obtuse-angulate than bent arcuate; ocelli no smaller proportionately than in male, similarly placed. Antennae subequal to the body in length.

Pronotum as in male but somewhat more robust, its greatest supra-coxal breadth contained but slightly more than three times in its length (as 16.5 to 52), the metazonal length with the same ratio to entire pronotal length as in male, greatest breadth of metazona (shaft) caudad subequal to the breadth of the prozona (collar) cephalad of supra-anal expansion, least breadth of metazona (shaft) two-thirds that across supra-coxal dilation (as 11 to 16); caudal margin of pronotum arcuate with a median angulate indentation; diverging raised surface areas of the prozona less evident than in the male; lateral margins of the metazona (shaft) with minute serrulate denticulations and these but little more evident than in the male.

Tegmina when closed leaving the apical third of the abdomen exposed, general form much as in male but slightly broader, their greatest breadth contained 3.3 times in their length (as 27 to 90); margins essentially as in male; venation as in male,[8] cross-veins and intercalated nervures little, if any, more evident than in male. Wings reaching to the tegminal apices, their venation of the same relatively simple type as the male.

Supra-anal plate strongly transverse, its median length two-sevenths of its proximal breadth, distal margin subarcuate, shallowly obtuse-angulate mesad and somewhat obliquely flattened laterad, surface of plate shallowly grooved meso-proximad of apical emargination, laterad the surface is obliquely declivent toward the oblique sections of the margin; cerci surpassing the apex of the subgenital plate by approximately twice the length of the supra-anal plate, tapering, general structure as in male; subgenital plate with its spout-like apical valves strongly compressed and sublamellate, rounded acute in profile.

Cephalic limbs heavier than in male, but having the same relative slenderness and lightness noted in that sex; cephalic femora with their greatest depth contained 4.8 times in their length (as 30 to 145), dorsal outline slightly more concave than in male, external surface similarly lacking denticles, ventro-internal margin with the second spine from the distal extremity subequal in length to the distal one, otherwise the formula is as in the male;[9] cephalic tibiae as in the male; cephalic tarsi subequal in length to the cephalic femora. Median limbs as in male except that the femora are very faintly less robust proximad and the tarsi are proportionately longer, equalling eleven-twelfths of the tibial length (as 44 to 48). Caudal femora slightly more slender and shorter proportionately, equal to 1.2 times the pronotal length (as 63 to 52).

Coloration.—General base color in the male pale ochraceous-buff usually over-washed with pale dull green-yellow (of Ridgway), also areally rather solidly clouded with honey yellow to pecan brown, the latter rarely solidly suffusing both or one of the tegmina except the marginal field, and tinting most of the pronotum; female with base color more brown buff, from as pale as cinnamon-buff to as dark as pecan brown. The dark maculations, evident as in all the species of this genus, range from snuff brown to as dark as clove brown, although generally bister, but vary greatly in intensity and density. The head in the male generally has a distinct transverse dark bar of variable outline immediately dorsad of the ocelli and another arcuate one across the facial scutellum, rarely these are obsolete in the male, and they are usually but not invariably absent or very faint in the female; the eyes range from blackish to bronzy brown; antennae fuscous except for the much paler basal segments (usually two). Pronotum in both sexes with paired dark sub-arabescoid figures at the point of greatest expansion and

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[8] One tegmen has four, the other five principal discoidal sectors. The male type has but four complete ones on each tegmen.

[9] Apparently due to accident the second spine in this series on the dextral cephalic femur is of the shorter category, and the next two are equally of the longer one.

Measurements (in millimeters)

	Length of body	Depth of head	Breadth of head	Length of pro-notum	Greatest breadth of pronotum	Length of meta-zona	Length of tegmen	Greatest breadth of tegmen	Length of cephalic femur	Length of median femur	Length of caudal femur
♂											
L. annulipes, Kartabo, Brit. Guiana[10]	23.5[11]	3.7	5.7	9.1	2.77	6.6	17.1	4.5	8.1	11.	11.5
L. cursor, Barro Colorado Island, C. Z., Pan., type	20.2	2.77	3.9	7.	2.11	5.	12.8	3.7	6.3	9.4	9.2
L. cursor, Barro Colorado Island, C. Z., Pan., paratype ..	23.6	3.	4.8	7.3	2.28	5.	13.3	3.7	7.1	9.7	9.1
♀											
L. annulipes, Nouveau Chantier, French Guiana[10]	25.2	3.7	5.7	8.1	2.44	5.8	14.5	4.4	7.3	10.2	10.1
L. cursor, Castilla Farm, C. R., allotype	28.2	3.7	5.5	8.4	2.70	6.	14.6	4.4	7.8	10.5	10.2
L. cursor, Castilla Farm, C. R., paratype	27.	3.4	5.2	7.9	2.60	5.7	14.3	4.	7.6	10.1	9.9
L. cursor, Hamburg Farm, C. R., paratype	29.	3.5	5.3	8.1	2.60	5.7	14.8	4.2	7.9	10.7	10.7

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[10] The dimensions of these specimens are added for comparison.

[11] Abdomen twisted.

similarly, but less complex, near the caudal margin, in addition to which the pronotal surface in the male sex bears numerous other dark touches, lines or dots (see figure 6), which, however, are much less evident in the female, and individually variable in emphasis in the male. Tegmina with their base color varying from the usual dull green-yellow to pecan brown, the base color of the marginal field always dull green-yellow, while over the whole is laid a pattern of numerous dark maculae of variable size, these varying in tone within the range already given. Wings in both sexes quite solidly infumate with natal brown to bone brown, the principal veins, particularly of the radiate field, solidly pencilled with bone brown, the cross-veins weakly outlined in whitish. All limbs markedly multiannulate, completely or incompletely, with dark, this pattern reaching to and involving all the tarsi; cephalic coxae more dark lineate than annulate, the external, extensor and internal faces showing proximal, median and distal patches, the median external one a lineation connected with that at the base; cephalic femora with external fasciae numbering five, internal surface with a distal and a post-median group, and a longitudinal one reaching from the base to the middle; cephalic tibiae with three dark groups, all tibial and femoral spines dark with pale bases; cephalic metatarsi tri-annulate, two of these closely placed proximad. Dorsum of abdomen mottled with pecan brown on a pale base, venter of abdomen pale, laterad narrowly lined intramarginally with dark; cerci pale dorsad and there subannulate with dark, ventral surface dark. In the female sex some of the ventro-external surface of the cephalic femora is infuscate between the large spines.

Paratypes.—I am considering all adult material examined, and listed below except the type and allotype, as paratypic.

Specimens examined.[12]—29; 14 ♂, 5 ♀, 10 juvs.

CANAL ZONE, PANAMA: Barro Colorado Island; XII, 28-31, 1948, I, 1-4, 1949, and no date (4); (Drs. Franz Schrader and Sally Hughes-Schrader); 12 ♂ (including type), 6 juv. ♂, 1 juv. ♀; [A.N.S.P.].

PANAMA: Trinidad River; III, 17, 1912, V, 7, 1911; (A. Busck); 1 juv. ♀, 1 very small juv.; [A.N.S.P.].

COSTA RICA: Castilla Farm, lower Rio Reventazón; VII, 23, 1936; (C. W. Dodge); 2 ♀ (including allotype); [A.N.S.P.]. Hamburg Farm, IV, 2; (C. W. Dodge); 1 ♀; [A.N.S.P.].[13] Turrialba; VI, 8, 1948; (F. Schrader); 1 ♂; [A.N.S.P.]. Near La Emilia, 1000 feet elevation; IX, 15, 1927; (Rehn); 1 ♀; [A.N.S.P.].[14] Estrella Valley; III, 1933: (C. H. Lankester); 1 ♀; [A.N.S.P.]. L. Diamantes; V, 31, 1948; 1 juv. ♂; [A.N.S.P.]. "Costa Rica"; 1 ♂; [A.N.S.P.].[14]

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[12] The material which was discussed by me in 1935 (Proc. Acad. Nat. Sci. Phila., LXXXVII, p. 200, footnote 72) as being erroneously labelled as from Ujarrás de Terraba, Costa Rica, also represents this species.

[13] One of a small series from this locality recorded by me in 1935 (vide supra, p. 199) as *L. annulipes*.

[14] Recorded by me in 1935 (vide supra) as *L. annulipes*.

Habits.—Dr. Sally Hughes-Schrader writes as follows regarding the habitat of this species and *L. actuosa,* also here described: " We took all our specimens of *Liturgousa* from tree trunks, and all but two from deep forest." Of the Turrialba specimen taken June 8, 1948, she writes: " It was on the trunk of an *Inga* tree in a cafetal of the Interamerican Institute, Turrialba, C. R." She adds that in both cases where it was in a " 'habitat modified by man' the forest lay close by." Regarding the Canal Zone material she states: " On Barro Colorado in the winter trip of 1948-49, we paid particular attention to how closely *L. cursor* and *L. actuosa* were associated. We never took both species from the same tree, but on January 1, 1949, we took *actuosa* from a tree less than fifty yards from one that carried *L. cursor.*" On January 4, 1949 in another environment, " the two species were found within 100 yards of each other." As to the relative distribution of the two species on Barro Colorado Island she writes: " We found *L. cursor* to be widely distributed over the whole island . . . ; while *L. actuosa* was found only at the eastern end. In 1940 *L. actuosa* was the more common," and she notes that they then took " only one of *L. cursor,*" while in the winter of 1948-49, " out of 20 specimens whose chromosomes could be determined 16 were *cursor* and only 4 *actuosa.*"

I have already noted[15] that the La Emilia female "was taken running up and down the heavily moss and lichen covered trunk of a gavilan tree (*Pentaclethra filamentosa*) in dense second-growth forest." I also noted " it was extremely active and difficult to capture, the markedly depressed form and the procryptic coloration making it exceedingly difficult for one's eyes to follow the crablike scuttlings around the tree trunk."

Chromosome numbers.—Dr. Sally Hughes-Schrader elsewhere is pointing out that *L. cursor* has but 23 diploid male chromosomes, while *L. actuosa* has 33. On the other hand, as she notes, *L. maya* has but 17.

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[15] Proc. Acad. Nat. Sci. Phila., LXXXVII, p. 201, (1935).

Liturgousa actuosa[16] new species (Figures 12-17.)

This species is more nearly related to *L. annulipes* of the Guianas than it is to the preceding sympatric *L. cursor*. It agrees with *annulipes,* and thus differs from *cursor,* in the more diverging and radiating longitudinal sectors of the tegmina, in the more conspicuous cross-veins of the same, and in the presence of raised tubercles on the external surface of the cephalic femora in both sexes, but these femora are little more robust than in *cursor.* From *annulipes,* however, *actuosa* differs in both sexes in the proportionately deeper and less strongly transverse head, in the broader and shorter pronotum, which has the shaft (metazona) comprising a slightly smaller proportion of the whole pronotum while the shaft is also less narrowed mesad, and in the median and caudal limbs, particularly the femora, being somewhat shorter proportionately. From *L. cursor,* here described, *actuosa* can be distinguished readily by a number of features, of which the more evident are the proportionately broader and shallower head, in the vertical axes of the eyes being more distinctly converging ventrad, hence the eyes are more oblique and less vertical as seen in cephalic aspect, in the pronotum being stouter and less attenuate, in the tegmina being more ovate in outline with the apex more subacute and median, in the more radiating characters of the sectors of the tegminal discoidal field and the more evident cross-veins of the same, the last being more complex, more irregular and distinctly less biseriate in disposition, in the longer and narrower wings with sharper apices and proportionately broader anterior field, the costal margin of which is more arcuate, while the longitudinal veins of the same field are more prominent and more arcuate, in the supra-anal plate of the male being much deeper, less strongly transverse and lobately produced mesad, and the median and caudal limbs being rather shorter proportionately, and particularly the caudal metatarsus which is much shorter than the pronotum (nearly or quite subequal in *cursor*).

Type.—♂ ; Barro Colorado Island, Gatun Lake, Canal Zone, Panama. January 1, 1949. (Dr. Franz Schrader, no. 637.) [Academy of Natural Sciences of Philadelphia, Type no. 5760.]

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[16] I. e. *active,* in allusion to the ability of species of this genus to move rapidly over the surface of tree trunks, their usual habitat.

The description of this species is largely comparative with the preceding detailed one of *L. cursor,* and the features here stressed are those of noteworthy difference from that of *cursor.*

Size very similar to that of this sex of *cursor* and in consequence small for the genus (length of body, 21.2 mm.) ; form slightly more robust than in *cursor*; surface of pronotum and of external face of cephalic femora with micro-tubercles as described under those areas, cross-veins of tegmina slightly more raised than in *cursor.*

Head strongly transverse as seen in cephalic aspect, its greatest depth contained 1.66 times in the breadth (as 18 to 30), occipital line more straight transverse than in *cursor* with the juxta-ocular lobes more rounded; ocelli proportionately even smaller than in *cursor,* similarly placed; facial scutellum as in *cursor* but infra-antennal concavities of the dorsal margin more pronounced; eyes with their vertical axes more distinctly converging ventrad than in *cursor,* as seen from the dorsum their globoseness cephalad is somewhat less pronounced than in the latter species.

Pronotum somewhat more robust than in the male of *cursor,* its greatest supra-coxal breadth contained approximately three times in its length (as 14.5 to 43), straight portions of the lateral margins of the precoxal section of the prozona (collar) shorter and less extensive than in *cursor,* lateral margins of the metazona (shaft) slightly less distinctly concave than in *cursor,* least breadth of metazona mesad approximately equal to eleven-fourteenths of that across supra-coxal lobes (as 11 to 14.5), caudal margin of pronotum broadly and bisarcuately subtruncate, median carina obsolete caudad on metazona (shaft), surface of prozona with arcuate raised area as described under *cursor* very weak, surface of metazona with scattered and well-spaced micro-granules; lateral margins, and chiefly of metazona (shaft), with spaced minute serrulate denticulations.

Tegmina when closed briefly surpassing the abdominal apex, elongate ovate in outline, the apex subacute and median in position (rather than nearer the costal margin as in *cursor*), both costal and sutural margins arcuate throughout and not subparallel in part as in *cursor,* greatest breadth at distal third contained nearly 3.5 times in the tegminal length (as 28 to 97) ; costal margin with its general arcuation sharpened in the distal fourth where it rounds to the apex, the same being true of the sutural margin; marginal field with its broader portion reaching farther distad than in *cursor*; the four major discoidal sectors pronounced and moderately radiating, cross-veins marked, their anastomosings complex and relatively irregular, usually not biseriate. Wings when closed reaching to the tegminal apices, the latter much more lobately produced beyond the general wing outline than in *cursor,* and in shape semi-ovate, with the whole costal margin definitely arcuate (nearly straight in *cursor*), greatest breadth of wing equal to three-fifths of its length (as 45 to 75) ; longitudinal sectors of the anterior field of the wing distinctly arcuate distad (virtually straight in *cursor*).

Supra-anal plate[17] moderately transverse, the median length equal to nearly half of the proximal breadth (as 15 to 35), the inter-cercal section roundly produced caudad with its margin regularly semi-ovate, and with a narrow median notch from which proximad there extends a fine carinulation for the greater part of the length of the plate; cerci twice as long as the subgenital plate, tapering, composed of 13 articles, the length ratios and general form of these articles as in *cursor*; subgenital plate rather broad scoop-shaped, narrowing distad, with its apex similarly but much more shallowly guttered, not as compressed laterad as in *cursor*, no evident styles.

Cephalic femora with their greatest depth contained 5.8 times (as 7 to 41) in their length, external surface with a medio-longitudinal roughly linear series of granular tubercles, which are irregularly biseriate in size, ventro-external (external flexor) margin armed as in *cursor* except that certain of the internal series of spines are larger and more intercalated between the second, third and fourth of the major series, ventro-internal (internal flexor) margin with 13 spines, the length formula (reading distad) being IIIIiIiIiIi, plus two proximal internal spines as described for *cursor*; cephalic tibiae with apical claw and marginal spines as in *cursor*; cephalic tarsi somewhat shorter than the cephalic femora (as 110 to 135), the metatarsus equal to half the total tarsal length. Median femora slightly shorter than in *cursor*, 1.21 times as long as the cephalic femora (as 165 to 135), form and character as in *cursor*; median tibiae equal to four-fifths the length of the median femora; median tarsi equal to seventeen-twentieths of the tibial length (as 34 to 40). Caudal femora almost equal to 1.2 times the pronotal length (as 51 to 43), slightly more slender than the median ones; caudal tibiae appreciably longer than the caudal femora (as 60 to 51); caudal tarsi shorter than the tibiae, equal to about five-sixths the length of the latter (as 51 to 60), the metatarsus as in *cursor* occupying three-fifths of the whole tarsal length, but much shorter than the pronotum (as 30 to 43).

Allotype.— ♀ ; Barro Colorado Island, Gatun Lake, Canal Zone, Panama. (F. & S. H.-Schrader, no. 13.) [Academy of Natural Sciences of Philadelphia.]

The following features are those of noteworthy difference from the above description of the type.

Size slightly larger than in the male sex (length of body, 27.2 mm.); form but slightly more robust than in male; surface essentially as in latter.

Head somewhat deeper proportionately than in male, its greatest depth contained twice in its greatest breadth (as 17 to 35), juxta-ocular lobes slightly higher and more evident but similarly rounded in outline; ocelli, facial scutellum and eye details as in male, except that the eyes are slightly less bullately globose. Antennae damaged.

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[17] Almost all the specimens available have the external genitalia telescoped or distorted by manipulation to removed internal parts, and the characters of the external male genitalia here presented have been drawn in greater part from the Barro Colorado male paratype collected by Banks.

Pronotum as described for male except that the least breadth of the shaft (metazona) is nearly two-thirds that across the supra-coxal dilation (as 12 to 17).

Tegmina when closed reaching to but not surpassing the apex of the abdomen, the costal and sutural margins less definitely arcuate and somewhat straighter, the apex slightly blunter and a little more rounded, greatest breadth at distal third contained 3.3 times in the tegminal length (as 32 to 106). Wings reaching to the tegminal apices.

Cephalic femora with their greatest depth contained 4.6 times in their length (as 10 to 46), external surface armed as in the male but to a somewhat more marked degree, ventro-internal (internal flexor) margin with 14 spines, the length formula of these as in the male except that the extra shorter spine accompanies that of the same length before the final pair in the series as set forth in the formula; cephalic tarsi even shorter proportionately than in the male, the ratio of tarsus to femur being as 110 to 148, the metatarsal length slightly less than half that of the entire tarsus (as 72 to 148). Median femora equal to faintly more than 1.1 times that of the cephalic femora (as 170 to 148); median tibiae with the same proportions relative to the median femora as in the male. Caudal femora slightly longer than the pronotum (as 170 to 157) but to a lesser degree than in the male sex; caudal tibiae nearly 1.2 times as long as the caudal femora (as 200 to 170); caudal tarsi[18] with extremity damaged.

Coloration.—General base color ranging from light ochraceous-buff to cinnamon, occasionally (two male paratypes) overwashed with winter green (of Ridgway), occasionally paler on lateral margins of pronotum than on the lighter sections of the pronotal disk; dark maculations ranging from russet to prout's brown, on the limbs as dark as bister or seal brown, as a whole varying greatly in solidity and intensity except as here discussed. The head dorsad of the antennae has a complex dark arabescoid pattern, but one element of which is a transverse bar immediately dorsad of the ocelli, while the facial scutellum is marked transversely with another, but all these features are less evident in the type and allotype than in the paratypic males, due to the more generally dull and less contrasted body coloration of the two former specimens; antennae fuscous except for the two proximal segments which are pale. Pronotum in general relatively uniform and dark in the type and allotype, but in at least several of the paratypic males with a symmetrically arranged pattern of triangles and oblique lines, especially on the prozona and cephalic half of the metazona. Tegmina mottled dark on light, the latter most evident along the costal margin and spaced out in patches along the longitudinal sectors of the discoidal field, anastomosing of cross-veins finely outlined with pale. Wings distad and over most of the anterior field heavily infumate with bister, paler in the more basal section

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[18] But one remains in the unique female seen.

Measurements (in millimeters)

	Length of body	Depth of head	Breadth of head	Length of pro-notum	Greatest breadth of pronotum	Length of meta-zona	Length of tegmen	Length of cephalic femur	Length of median femur	Length of caudal femur
♂, Barro Colorado Island, C. Z., Pan., type	21.2	2.93	4.8	7.	2.36	4.8	15.8	6.6	8.4	8.3
♂, Barro Colorado Island, C. Z., Pan., paratype	21.	2.93	5.	6.8	2.28	4.7	15.3	6.1	7.9	7.3
♀, Barro Colorado Island, C. Z., Pan., allotype	27.2	2.77	5.7	8.1	2.77	5.7	17.2	7.4	9.1	8.4

of the radiate field, the veins of the radiate field, however, like those of the anterior field, solidly lined with fuscous. All limbs markedly multiannulate with dark, as usual in the genus, these complete or incomplete, reaching to and involving the tarsi to a greater or lesser degree, and in general essentially as described for *L. cursor*. Dorsum of abdomen buckthorn brown marked with prout's brown, venter of abdomen ranging from as pale as olivine to tawny-olive, relatively uniform; cerci bister, occasionally paler dorsad. In both sexes some of the ventro-external surface of the cephalic femora is infuscate between the larger spines.

Paratypes.—I am considering all adult material examined, in addition to the type and allotype, as paratypic.

Specimens examined: 10; 8 ♂, 1 ♀, 1 juv. ♀.

CANAL ZONE, PANAMA: Barro Colorado Island; I, 1 and 4, 1949; (Drs. Franz and Sally Hughes-Schrader); 4 ♂ (including type): no date; (Drs. Franz and Sally Hughes-Schrader); 3 ♂, 1 ♀ (allotype): VII, 13 (juv.) and 26, 1924; (Nathan Banks); 1 ♂, 1 juv. ♀; [all A.N.S.P.].

Habits.—Dr. Sally Hughes-Schrader has kindly furnished me with valued notes on the habits, etc., of this and the preceding species. These have already been quoted at some length under *L. cursor,* and the student is referred to a preceding page for this information. The type of the present species was taken from a tree trunk along a trail in heavily wooded upper levels at the eastern end of Barro Colorado Island, while other males were secured in a low-lying forest stretch in the same area.

Chromosome numbers.—It has already been pointed out on a preceding page that Dr. Sally Hughes-Schrader has found *actuosa* has 33 diploid male chromosomes, while *cursor* has but 23, and *maya* 17.

EXPLANATION OF FIGURES

Mantoida schraderi new species. Female (type). Turrialba, Costa Rica. Fig. 1.—Dorsal view (× 2.4). Fig. 2.—Lateral view of portion of body (× 3.2). Fig. 3.—Cephalic view of head (greatly enlarged).

Mantoida schraderi new species. Male (allotype). Barro Colorado Island, Canal Zone, Panama. Fig. 4.—Dorsal view (× 2.6). Fig. 5.—Cephalic view of head (greatly enlarged).

Liturgousa cursor new species. Male (type). Barro Colorado Island, Canal Zone, Panama. Fig. 6.—Dorsal view (× 2.1). Fig. 7.—Lateral view (× 2.1). Fig. 8.—Cephalic view of head (greatly enlarged).

Liturgousa cursor new species. Female (allotype). Castilla Farm, lower Rio Reventazón, Costa Rica. Fig. 9.—Dorsal view (× 1.9). Fig. 10.—Lateral view (× 1.9). Fig. 11.—Cephalic view of head (greatly enlarged).

Liturgousa actuosa new species. Male (type). Barro Colorado Island, Canal Zone, Panama. Fig. 12.—Dorsal view (× 2). Fig. 13.—Lateral view (× 2). Fig. 14.—Cephalic view of head (greatly enlarged).[19]

Liturgousa actuosa new species. Female (allotype). Barro Colorado Island, Canal Zone, Panama. Fig. 15.—Dorsal view (× 2.4). Fig. 16.—Lateral view (× 2.4). Fig. 17.—Cephalic view of head (greatly enlarged).

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[19] In this view the occiput is tilted back slightly more than in the other head views here given.

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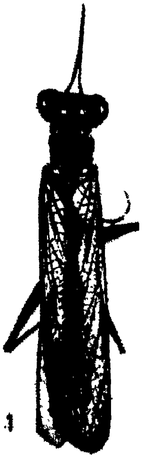

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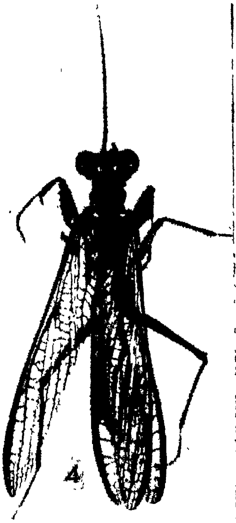

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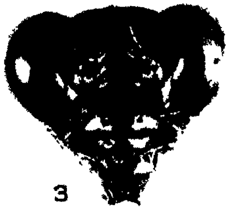

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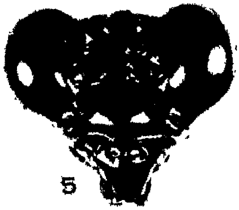

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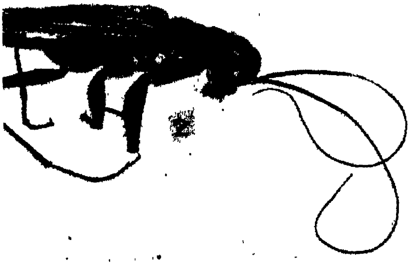

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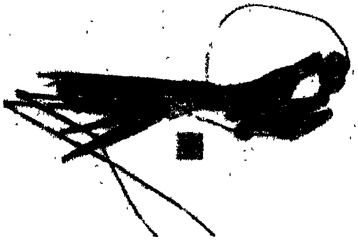
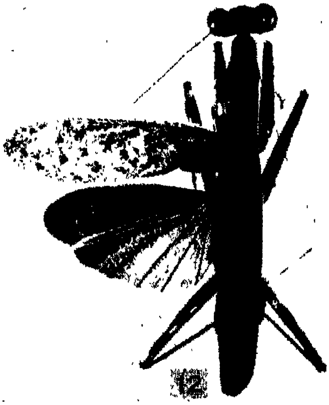
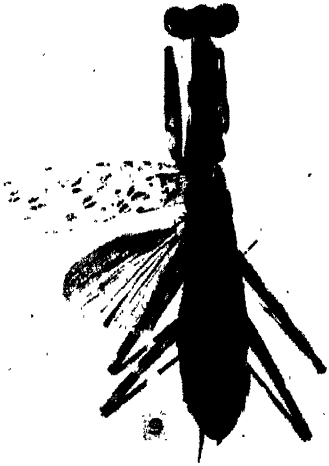
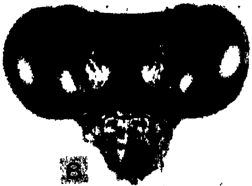
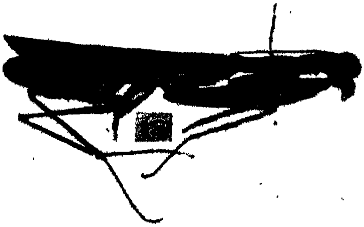


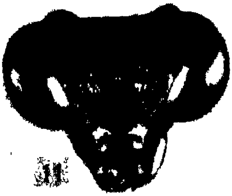
REHN—NEW CENTRAL AMERICAN MANTOIDEA

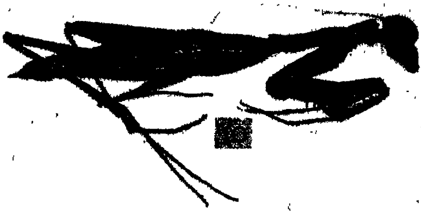


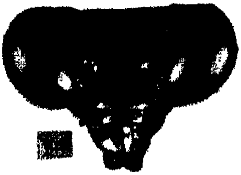












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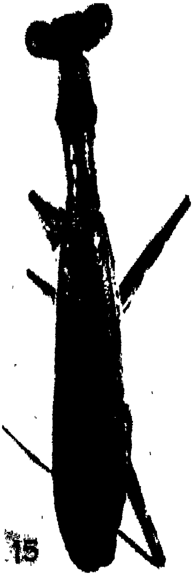

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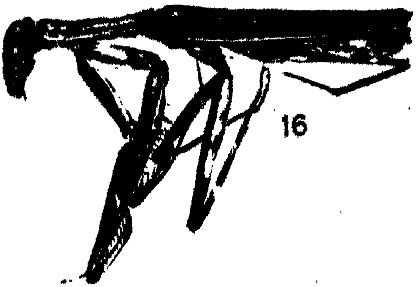

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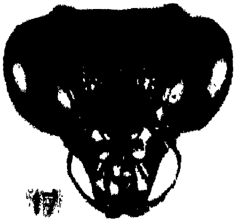

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REHN—NEW CENTRAL AMERICAN MANTOIDEA

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